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User's Manual

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Operating Documentation

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GE Medical Systems

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Introduction

EchoPAC PC is a post processing program designed for ultrasound image review, analysis and reporting. EchoPAC PC allows post-processing of DICOM ultrasound images and raw data images from GE ultrasound scanners.

Main functionality

EchoPAC PC offers the following functionality:

- Read/display DICOM ultrasound and GE raw data images.
- Ultrasound image optimization, as on a scanner.
- Measurement and analysis
- Advanced quantitative analysis, based on raw data such as quantitative TVI, contrast and stress analysis (research options)
- Image storage
- Patient record database
- Report generator

Attention

Read and understand all instructions in the User's Manual before attempting to use the EchoPAC PC. Keep the manual with the equipment at all time. Periodically review the procedures for operation and safety precautions.

CAUTION

For USA only:

United States law restricts this device to sale or use by, or on the order of a physician.

Indications for use

EchoPAC PC is indicated for diagnostic review and analysis of ultrasound images acquired via B, M, Color M modes, Color, Power, Pulsed and CW Doppler modes, Coded Pulse, Harmonic and Realtime 3D. Clinical applications include: Fetal; Abdominal; Urology (including prostate); Pediatric; Small Organ (breast, testes, thyroid); Neonatal and Adult Cephalic;

Cardiac (adult and pediatric); Peripheral Vascular; Transesophageal (TEE); Musculo-skeletal Conventional; Transrectal (TR); Transvaginal (TV); and Intraoperative (abdominal, thoracic and vascular).

EchoPAC PC product range

The EchoPAC PC product range consists of:

- **EchoPAC PC Workstation**: a turnkey solution consisting of hardware and software in a complete package.
- **EchoPAC PC Software Only**: only the software to be installed on any PC that fulfills minimum requirements.

△
CAUTION

EchoPAC PC Software Only must NOT be installed on computers, which control life-supporting or patient monitoring devices.

The EchoPAC PC Workstation and The EchoPAC PC Software Only have the same clinical functionality, except for the following features that are not available in EchoPAC PC Software Only:

- No writing directly to CD-RW (Must be done by other software packages).
- The TCPIP settings cannot be configured within the application (it must be done in Windows).
- InSite/iLink is not available.
- Removable media cannot be formatted within the application.
- Removable media cannot be ejected from within the application.
- The printer setup cannot be done from within the application.
- The Computer name cannot be set from within the application.

Important

△
CAUTION

To ensure optimal performance, do NOT attempt to install any software on the EchoPAC PC workstation.

△
CAUTION

The EchoPAC PC workstation must NOT be placed inside the patient environment (refer to local regulations and EN 60601-1-1 (2000)).

1. Patient environment

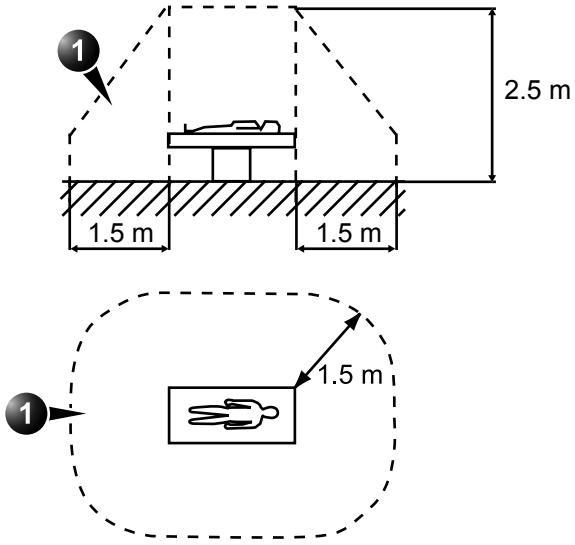

Figure 1-1: The patient environment

Manual contents

The EchoPAC PC User manual is organized to quickly provide the information needed for patient management and ultrasound image post processing using the EchoPAC PC software.

Finding information

Data has been arranged in a format that will assist the user in finding information easily and quickly.

Table of Contents: list the main topics and their location.

Headers and footers: displays the chapter name and page number.

References: cross references are noted in the text.

Index: Extensive tool that provides easy reference to ideas, topics, terms, titles, headings and cross references.

Conventions used in this manual

The following typographic conventions are used in the indication of different types of information:

2-columns layout: the right column contains the main text, the left column contains additional notes and warning texts.

Bold type: describes button name on the screen.

Italic type: describes program windows, screens and dialogue boxes.

Contact information

If additional information or assistance is needed, please contact the local distributor or the appropriate support resource listed bellow:

Europe GE Ultraschall KG Deutschland GmbH & Co. Beethovenstraße 239 Postfach 11 05 60 D-42655 Solingen	 Tel: 0130 81 6370 Tel: (49)(0) 212-28-02-208
USA GE Medical Systems Ultrasound Service Engineering 4855 W. Electric Avenue Milwaukee, WI 53219 On-line Applications Support	 Tel: (1) 800-437-1171 Fax: (1) 414-647-4090 Tel: (1) 800-682-5327 or (262) 524-5698
Canada GE Medical Systems Ultrasound Service Engineering 4855 W. Electric Avenue Milwaukee, WI 53219 On-line Applications Support	 Tel: (1) 800-664-0732 Tel: (1) 800-682-5327 or (262) 524-5698
Asia GE Ultrasound Asia Service Department Ultrasound 298 Tiong Gahru Road # 15-01/06 Central Plaza Singapore 168730	 Tel: (65) 291-8528 Fax: (65) 272-3997

Latin and South America GE Medical Systems Ultrasound Service Engineering 4855 W. Electric Avenue Milwaukee, WI 53219 On-line Applications Support	 Tel: (1) 305-735-2304 Tel: (1) 800-682-5327 or (262) 524-5698
Brazil GE Ultrasound Rua Tomas Carvalhal, 711 Paraiso Cep: 04006-002 - São Paulo, SP	 Tel: (55.11) 887-8099 Fax: (55.11) 887-9948

Chapter 1
Getting started

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Launching EchoPAC PC

To start EchoPAC PC

1. Start the EchoPAC PC workstation.
   The unit undergoes an initialization sequence and the *Operator login dialogue box* is displayed (see Figure 1-1).
2. Enter the required information and press **Log on**.
   The *Search/Create patient window* is displayed with the default dataflow selected (see Figure 2-1, page 14).

1. **Select the operator**
2. **Enter password**

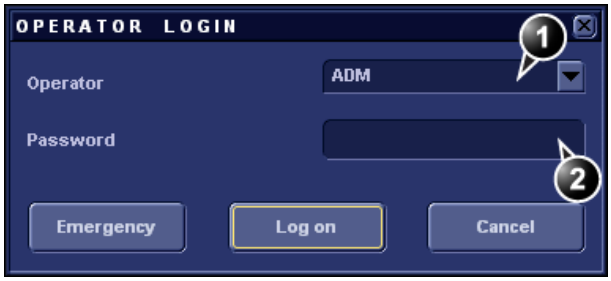


Figure 1-1: The Operator login windows

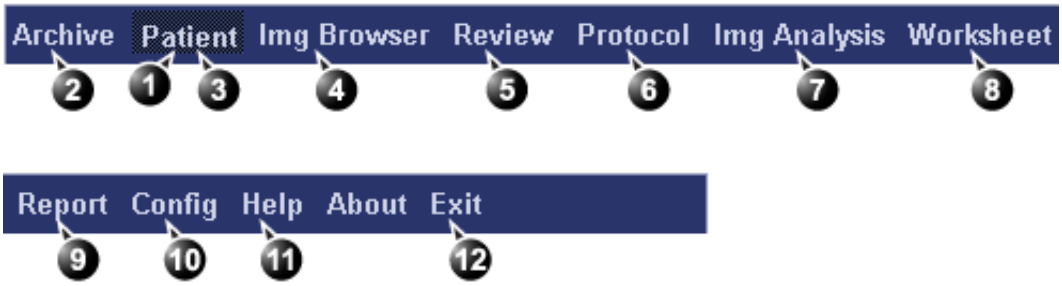
△
CAUTION

For user of EchoPAC PC Software Only:

It is possible in Windows to start several instances of EchoPAC PC. I.e. the same application is launched more than once. It is strongly recommended not to do this, as this will cause several functions and features in EchoPAC PC not to work properly. Only ONE instance of EchoPAC PC should be running.

EchoPAC PC **overview**

EchoPAC PC is build on eight different main screens that can be entered by selecting the buttons in the top of the window (see Figure 1-2).



1. **Selected screen**
2. **Archive**
   - **Search patient**
   - **Create patient**
3. **Patient:**
   - **Patient info**
   - **Examination list**
   - **Medical info**
4. **Image Browser:**
   - **Displays a thumbnail overview of all images stored for the current patient record**
5. **Review:**
   - **Displays all images of the selected examination**
6. **Protocol:**
   - **Review protocol based examinations**
7. **Image Analysis:**
   - **Image optimization**
   - **Measurements**
   - **Quantitative analysis**
8. **Worksheet:**
   - **Measurements listing**
9. **Report:**
   - **Summarizes data from examination**
10. **Config:**
    - **EchoPAC PC configuration**
11. **Help:**
    - **Displays on-line user documentation**
12. **Exit**

Figure 1-2: The EchoPAC PC navigation buttons

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Searching a Patient record

When the login procedure is completed, the *Search/Create patient window* is displayed (see Figure 2-1).

About dataflow

Refer to page 311 for further information on connectivity setup.

The connectivity on EchoPAC PC is based on the dataflow concept. Each dataflow defines the transfer of patient information from an input source to the unit, and from the unit to an output source. Patient information can include demographic data and images, as well as reports and Measurement and Analysis data. A dataflow is a set of pre-configured services. When beginning a search, the user selects a pre-configured dataflow (see page 311 about connectivity) that will automatically customize EchoPAC PC to work according to the services associated to the dataflow and search in the archive associated.

To find a patient record

EchoPAC PC can be configured to generate patient ID.

1. Type the patient **Last Name**, and/or **ID**.
   When default configured, EchoPAC PC automatically searches to see if the patient is already in the database. The result of this search is displayed in the *Patient list field*.

The automatic searching tool displaying matching patient information in the Patient list can be turned off.

2. If necessary, select another **dataflow** to search in other databases.
3. In the *Patient list field*, Double-click the desired patient record (or click once on the patient record and press **Select Patient**)
   Or
   Press **[+]** in front of the actual patient record and select the desired examination.
   The *Examination List window* is displayed (see Figure 2-2).

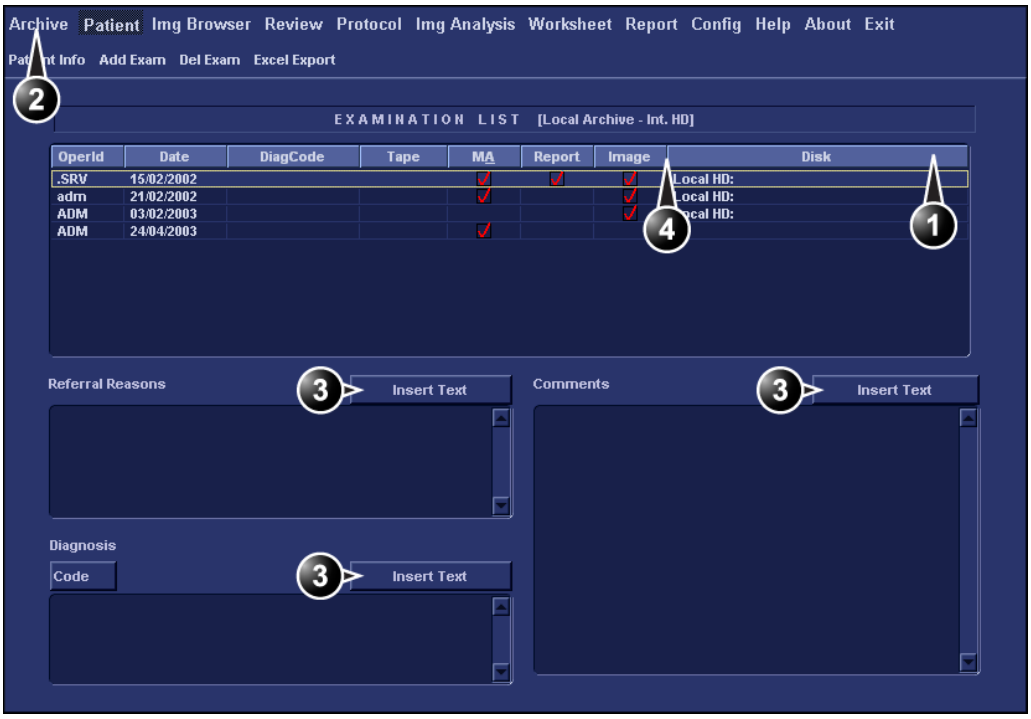
△
CAUTION

In a network environment, if the user tries to open a patient record or an examination that is already opened by another user, a warning message is displayed. Do NOT attempt to open the study that is already opened by another user.

1. **Press one of the headings to sort the list accordingly.**
2. **Select new archive and other pre-defined services**
3. **The system can be configured to display the Advanced search tool as default (see page 322)**
4. **Select the column heading border and drag to adjust column width**
5. **Expended Patient record displaying belonging examinations**

The Search/Create patient window may be slightly different depending on the Dataflow selected.

Figure 2-1: The Search/Create Patient window



1. **The information displayed in the Patient list is configurable (see page 322).**
2. **Go to Search/Create Patient window (see page 14)**
3. **Insert pre-defined text in the Comment field**
4. **Select the column heading border and drag to adjust column width**

Figure 2-2: The Examination list window

Advanced search

The list of searching filters may vary depending on the dataflow selected

To restrain the search to a specific patient group, one or more filters may be applied to the search. The table below shows the filters applicable to a patient search:

Searching filter
Echolab
Diag. code
Date of birth (time span)

Searching filter
Examination date (time span)
Current date
Images
Stress examinations
Report

Sorting data

The search result can be sorted according to the fields displayed in the patient list, in ascending or descending order.

To sort data

1. In the *Patient list field*, click on the **header** by which the sort is to be performed (Figure 2-1, page 14).
   The patient list is sorted in ascending order according to the field selected.
2. Click once more on the **header**.
   The patient list is sorted in descending order according to the field selected.

Printing patient list

1. In the *Search/Create patient window*, select **Print Patients**.
   The displayed patient list is printed.

Editing Referral Reasons, Comments and Diagnosis

CAUTION

The user is responsible for patient demographic data, diagnostic information or any other patient related information entered in the database.

The user can edit the actual text in the *Examination List window* (see Figure 2-2) using the alphanumeric keyboard and by inserting pre-defined text input.

Text edition

1. In the *Examination list window* (Figure 2-2), select the required field to activate the text marker.
2. Using the alphanumeric keyboard, edit the information.

Use the Arrow keys to move text marker.

Inserting pre-defined text input

1. In the *Examination list window*, press **Insert Text** for the actual field.
   The *Insert text window* is displayed (see Figure 2-3).
   The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third column.
2. Navigate through the pre-defined text list by selecting items in the columns and double-click on the desired pre-defined text to be inserted. If an entry in the third column is inserted, the selected text in the second column is also inserted.
   Press **More>>** to display the full text for the selected entry.

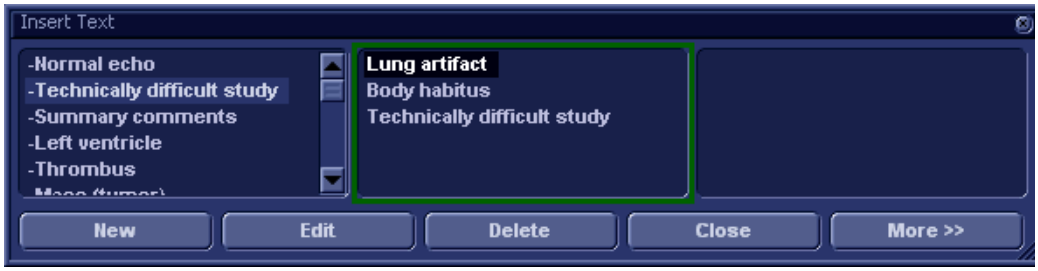


Figure 2-3: The Insert text window

Creating, editing and deleting text input

These features are described in the section ’Direct report’ on page 90.

Diagnosis code

Entering a Diagnosis code

1. In the *Examination list window*, select **Code** (see Figure 2-2).
   The *Entered Code window* is displayed.
2. Select **Add**.
   The *Code list window* is displayed.
3. Double-click the code to enter.
   The Code selected is displayed in the *Examination list window*.

1. **The Entered code window**
2. **The Code list window**

Figure 2-4: Entering Diagnosis codes

Deleting an entered Diagnosis code

1. In the *Examination list window*, select **Code** (see Figure 2-2).
2. In the *Entered code window*, select the code to delete and press **Delete**.

Creating a Diagnosis code

1. In the *Examination list window*, select **Code** (see

Figure 2-2).
The *Entered code window* is displayed.

2. Select **Add**.
   The *Code list window* is displayed.
3. Select **New**.
4. Enter the new code.
5. Select **Done** to exit.

See also ’The diagnostic codes sheet’ on page 308.

Editing demographic data

WARNING

If you modify the Patient ID, Last name, First name or Date of birth on a patient in the archive, be aware that the contents of the archived images for that patient is not updated. If the images are still in the buffer and not yet archived, the image files are updated if you modify any patient information, but not if the images are archived. So if any of these images are later on exported to DICOM media or DICOM server, they will still contain the original patient information, as it was before you did the modification in the archive. The system does not alter the contents of the image files at all when doing DICOM export.

The demographic data for a selected patient record can be edited from the *Patient Information window*.

CAUTION

Do NOT use '\' or '^' in patient information fields, as these characters might cause problems with some DICOM devices.

1. Select a patient record (see page 13) and press **Patient Info** in the *Examination List window* (see Figure 2-2). The *Patient information window* is displayed (see Figure 2-5).
2. Edit the information using the keyboard or by choosing a new selection from the drop-down menus.
   Select the patient information category to enter application specific patient information (Displayed when the button **More** is depressed, see Figure 2-5.).

1. **The date format is configurable (see page 328).**
2. **The window can be configured to display the expanded patient info as default (see page 322).**
3. **The Address field is configurable (see page 322).**
4. **Select patient information category.**

Figure 2-5: The Patient information window

Creating a new Patient record

EchoPAC PC can be configured to generate patient ID.

1. In the *Search/Create Patient window* (see Figure 2-1), enter patient **Last Name**, and/or **ID**.
2. press **Create Patient**.
   The *Patient Information window* is displayed (see Figure 2-5).
3. Enter the necessary patient information.

△
CAUTION

Do NOT use '\' or '^' in patient information fields, as these characters might cause problems with some DICOM devices.

Deleting archived information

Deleting a patient record

1. Select the patient record to delete (see page 13).
2. In the *Search create Patient window* (Figure 2-1, page 14), press **Delete**.
   A dialogue window is displayed asking for confirmation.
3. Press **OK** to delete the patient record.

Deleting an examination

1. Select the examination to delete (see page 13).
2. In the *Examination list window* (see Figure 2-2), select **Del Exam**.
   A dialogue window is displayed asking for confirmation.

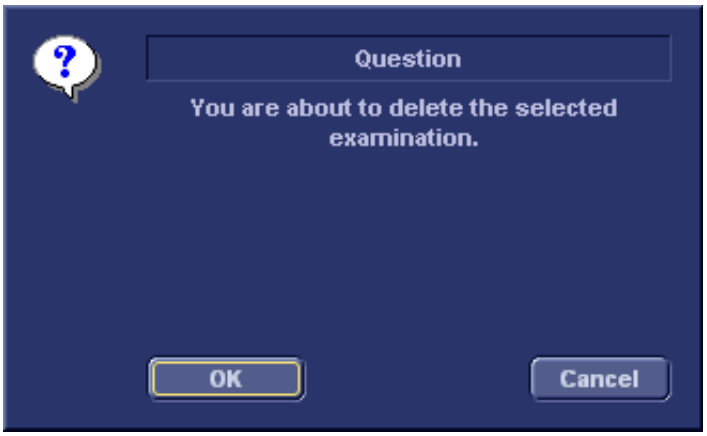


Figure 2-6: Delete Examination prompt

Moving examinations

Examinations can be moved from one patient record to another.

1. In the *Search/Create Patient window* press **[+]** in front of the patient record containing the examination(s) to move (see Figure 2-1, page 14).
2. Select the examination to move.
   To select several examinations, press and hold down **CTRL** or **SHIFT** while selecting.
3. Press **Move Exam**.
   The *Move exam window* is displayed.

Figure 2-7: The Move exam window

4. Search and select the target patient record.
5. Press **Move Exam**.

A warning message is displayed asking the user to confirm the action to perform (see Figure 2-8).

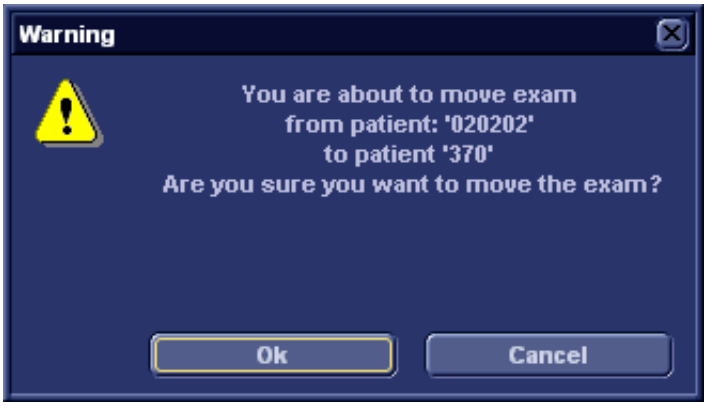


Figure 2-8: Moving examination prompt

6. Press **OK**.
   An information window is displayed to confirm the operation.
7. Press **OK**.

Using removable media

The following removable media can be used for data storage:

- 5 1/4” R/W Magneto Optical disk (MOD) (from Sony only, 1.2, 1.3, 2.3, 2.6, 5.2, 8.6 and 9.1 Gb) (Option)
- 3 1/2” Magneto Optical disk (from Sony only, 1.3 Gb), option
- USB Flash card
- Zip disk (250 Mb), option
- CD-R (CD-RW is not supported.)
- DVD-R

△
CAUTION

CD/DVD:

- ***Do not use CD-R/DVD-R for permanent storage of patient data.***
- ***Use only 24x or higher CD-R.***

USB Flash card:

- ***If the USB Flash card is also to be used on a Vivid 7, Use only shielded USB Flash cards that are verified for EMC performance according to EN55011 Class B. The use of other USB Flash cards may cause interference on the system itself or on other electronic devices.***

Recommendation concerning CD and DVD handling

To avoid data loss, never touch the recordable surface of a disk. Handle the disk only by the outer edge. Do not place it face down on a hard surface. Fingerprints or scratches will make the disk unusable. Before usage, verify that the disk surface has no visible scratches. If there are any scratches, do NOT use the disk.

Formatting removable media

MOD, Zip disk, CD-R and DVD-R have to be formatted before use as described below.

△
CAUTION

The formatting process will erase any data present on the disk.

Note: Removable media used during Disk space management or Backup do not need to be formatted, the formatting process is part of these procedures.

To format a removable media:

1. Insert the media in the drive.
2. Select **Config** (F2).
3. If required, log on to the system.
   The Configuration package is opened.
4. Select the category **Connectivity** and select the sheet **Tools** (Figure 2-9).

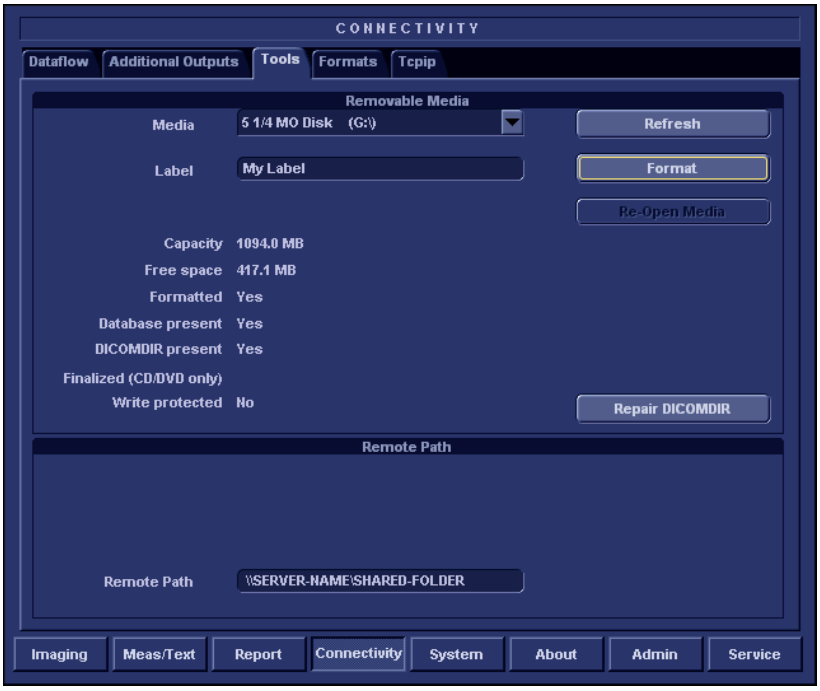


Figure 2-9: The Tools sheet

5. Select the removable media from the *Media pop-up menu*.
6. Enter a name for the removable media in the *Label field*.
   Note: Only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.
7. Select **Format**.
   A confirmation window is displayed.
8. Select **OK** to continue.

9. Wait for the display of the *Information window* indicating that the formatting process is completed.
10. Select **OK**.
11. Eject the media as described below.

Ejecting removable media

Do not eject the media using the button on the drive.

1. Press **ALT**+**E** to eject the disk.
   The *Eject device menu* is displayed (Figure 2-10).

Figure 2-10: The Eject device menu

2. Select the relevant media.
   The selected media is ejected.

CAUTION

When ejecting a MOD, the disk is half way ejected from the MOD station. To avoid unintentional automatic re-insertion, take out the MOD from the MOD station.

Export/Import patient records/examinations

Patient records/examinations from the local archive on one system (EchoPAC PC or EchoPAC PC) can be exported to the local archive on another system via a removable media. Patient records/examinations from the local archive can also be exported directly to a remote archive (Echo server, DICOM server or EchoPAC PC depending on the environment). In addition patient records/examinations from a remote archive (Echo server or EchoPAC PC depending on the environment) can be exported to a removable media or to a DICOM server. Database information (patient and report archives) can be exported with or without images. No data is deleted from the source archive when exporting data unless the command **Delete selected patient(s) after copy** is checked in the Export patient window (see Figure 2-15, page 33).

Similarly, patient records/examinations from the local archive on one system can be imported to the local archive on another system via a removable media. Database information can be imported with or without images. No data is deleted from the source archive when importing data. In addition patient records from a removable archive can be imported to a remote archive (Echo server).

△
CAUTION

If an examination is opened, it must be closed before performing Export/Import of patient records/examinations to guarantee that all data is included in the transfer.

Exporting patient records/examinations

1. Insert a removable media in the drive.
2. Press **Archive**.
   The *Search/Create Patient window* is displayed (see Figure 2-1, page 14).
3. Select the source archive in the *Dataflow field*:
   - **LocalArchive-Int.HD**: exports data from the local archive.
   - **RemoteArch-RemoteHD**: exports data from an Echo server.
4. Press **Export** in the *Search/Create Patient window*.
   The *Export dialogue window* is displayed.

Figure 2-11: The Export Dialogue window

5. Select one of the following destinations from the *Destination drop-down menu*:
   - **MOD Archive**: exports raw and DICOM (if present) data to a removable MOD.
   - **DICOM MOD 5.25/3.50**: export DICOM data only to a removable MOD.
   - **CD/DVD Archive**: exports raw and DICOM (if present) data to a CD/DVD.
   - **DICOM CD/DVD**: export DICOM data only to a CD/DVD-R/W.
   - **Remote Import/Export Archive**: exports raw and DICOM (if present) data to an Echo server (network).
   - **DICOM Server**: exports DICOM data only to a DICOM server.
   - **Excel file**: exports data to a spreadsheet. The export destination must be configured (see page 35).
   - **DICOM Print**: prints images to a DICOM printer via DICOM spooler.
   - **MPEGVue**: exports examinations to MPEGVue format readable from a regular computer. Ultrasound images are stored as MPEG, measurements as an Excel file and saved reports as CHM-files.

     The export destination must be configured (see page 35).
6. Press **OK**.
   The following situations may occur:

- The system is checking that the removable media is inserted. If not, a dialogue window is displayed prompting the user to insert a media.

Figure 2-12: Insert media window

Insert the media and select **Retry**.

- The system is checking if the destination media is empty and needs to be formatted. If yes an *Information window* is displayed asking the user whether or not to format the media.

Figure 2-13: Media formatting window

If desired enter a new label and select **OK**.

Note: only the following characters and signs can be used when labelling a media: A - Z, a - z, 0 - 9, “_” and “-”. Do not use more than 11 characters or signs. Do not use space.

- If the media is not empty, the *Add files window* is displayed.

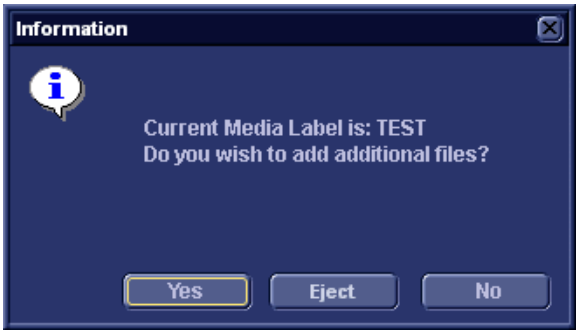


Figure 2-14: Add files windows

Select **Yes**.

The system is preparing the media to allow addition of new files.

The *Export patient window* is displayed (see Figure 2-15).

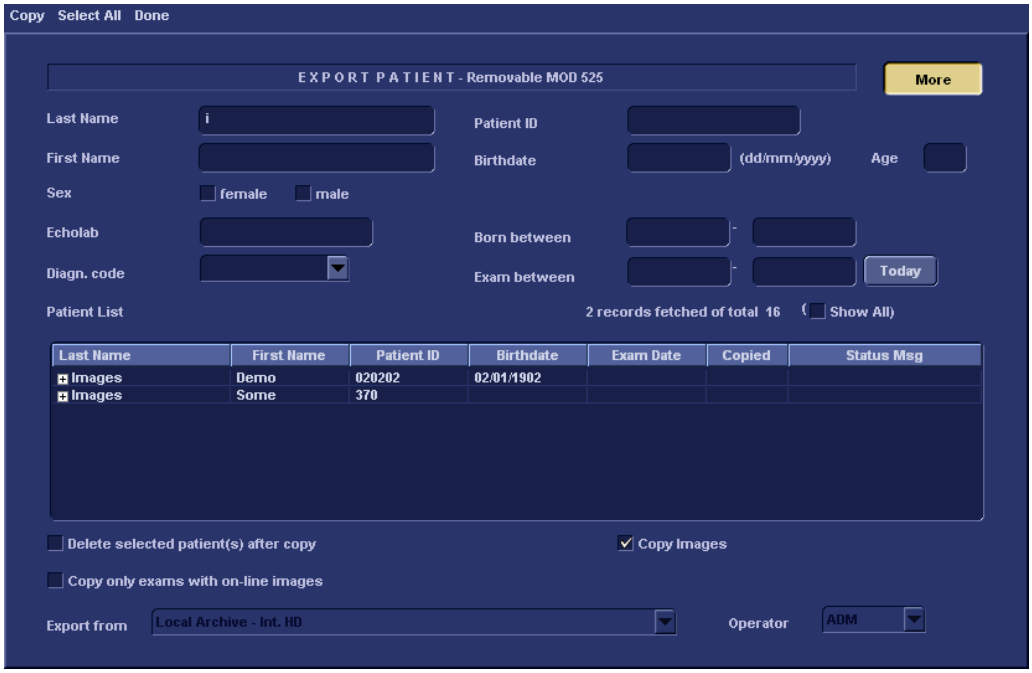


Figure 2-15: The Export patient window

7. Search and Select the patient records to export in the *Patient list*.
   The following selection methods can be used:
   - Press and hold down **SHIFT** while selecting patient records/examinations to select several consecutive items at a time.
   - Press and hold down **CTRL** while selecting patient records/examinations to select several discrete items.
   - Press **Select all** in the *Export patient window* to export all patient records.
   - Press **Today** to display today's examinations and select the actual examinations.
   - Fill in the *Exam between field* to display the patient records done during a specific time period and select the actual records.
   - Fill in the *Born between field* to display the patient records of patients born during a specific time period and select the actual records.
8. Adjust the following settings (if available) as desired:
   - **Delete selected patient(s) after copy**
   - **Copy images**
9. Press **Copy**.
   If one or more patient examination is already present in the destination archive the *Export/Import conflict window* is displayed (see Figure 2-16). For each conflicting item, select:
   Keep: to keep the existing examination in the destination archive.
   Replace: to replace the existing examination with the corresponding item in the source archive.

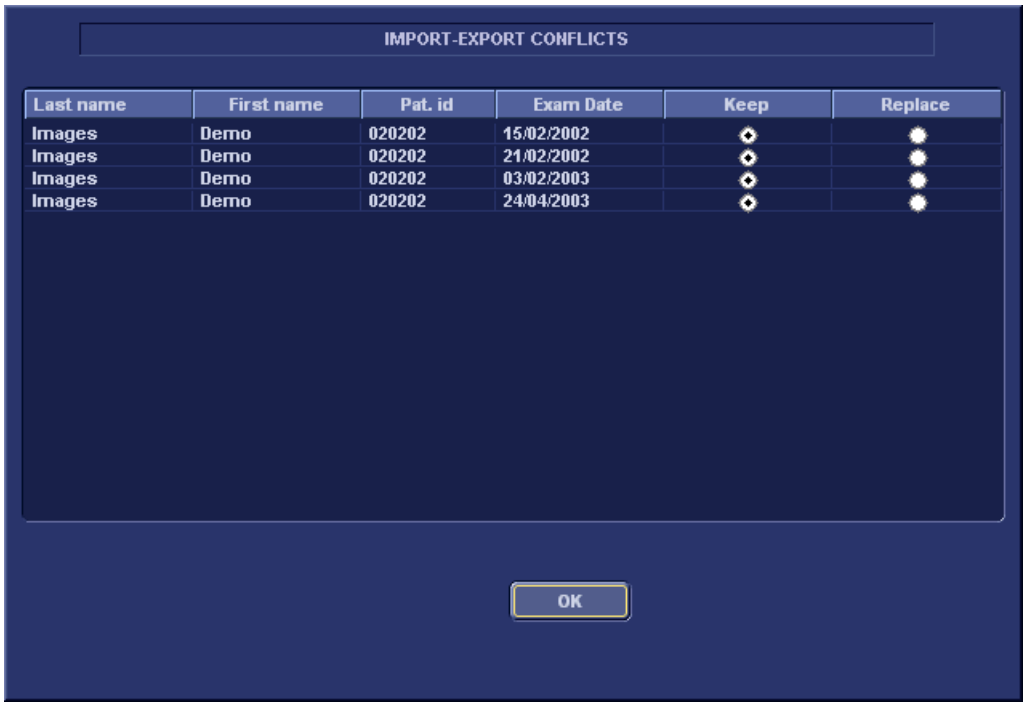


Figure 2-16: The Export/Import conflict window

Press **OK** to resume export.
A progress indicator is displayed. When done a status window is displayed showing the number of patient records that have been successfully exported.

10. Press **OK**.
    A check mark is displayed in the *Copied field* in the *Export patient window* for each patient exported (see Figure 2-15).
    A status message is displayed for each item exported. Make sure that the operation was successful for each item exported.
11. Press **Done** in the *Export patient window* to complete the process.

Do not eject the CD using the button on the CD drive

12. Press **ALT**+**E** to eject the disk.
    The *Eject device menu* is displayed.

Figure 2-17: The Eject device menu

13. Select the relevant media.
    The selected media is ejected.

Export configuration

The destination for Export of patient records to Excel and MPEG must be configured prior to use. This is done from the *Dataflow sheet* in the Configuration package.

To display the *Dataflow sheet*:

1. Select **Config** (F2).
2. Select the **Connectivity** category and **Dataflow** subgroup. The *Dataflow sheet* is displayed (Figure 2-18).
3. If not already checked, select the option **Show only Imp/Export**. This will display only the dataflows related to the Import/Export function.
4. Select the dataflow **Misc. Export** in the *Name pull-down menu*.

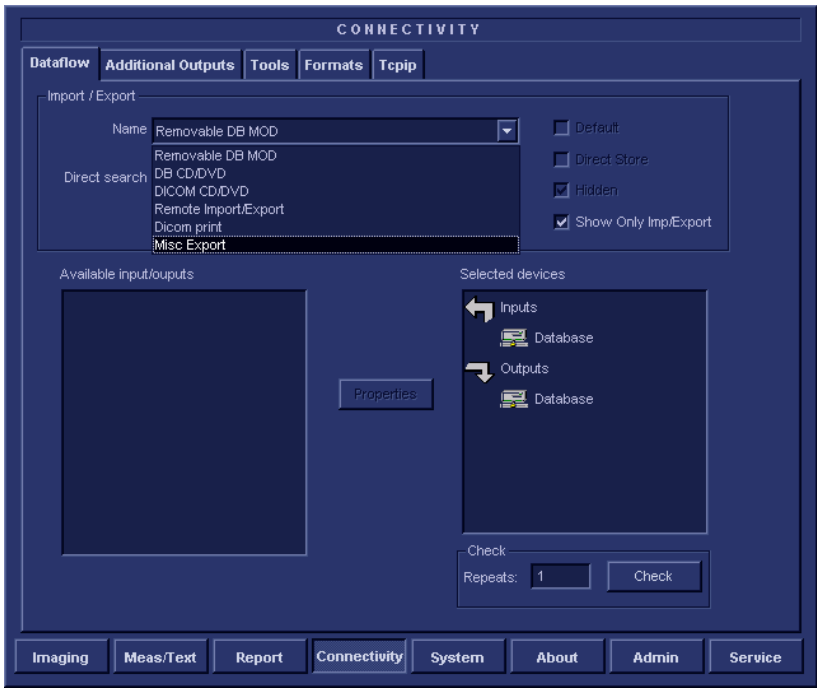


Figure 2-18: The Dataflow sheet

Export to Excel configuration

1. Select the **Excel storage** device in the *Selected devices pane* and press **Properties**.
   The *Excel properties window* is displayed.

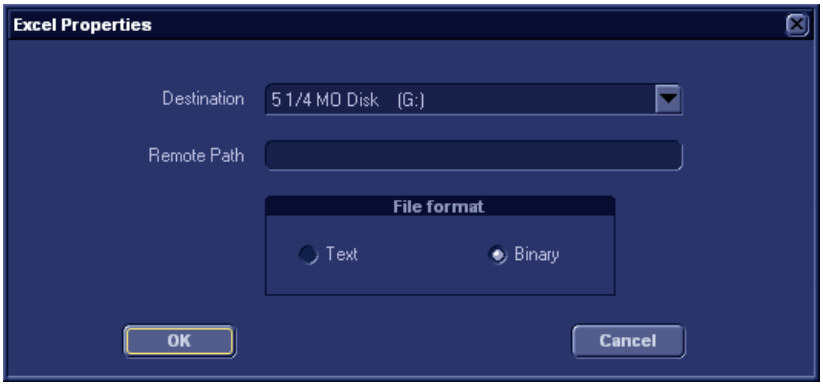


Figure 2-19: The Excel properties window

2. Select a removable media or a network volume remote path as the destination in the *Destination Pull-down menu*.

Note: Remote paths of network volumes must be entered once in the *Remote path field* before they can be selected from the *Destination Pull-down menu*.

3. Select **OK** and press **CONFIG** (**F2**).

Export to MPEGVue configuration

1. Select the **eVue** device in the *Selected devices pane* and press **Properties**.
   The *eVue properties window* is displayed.

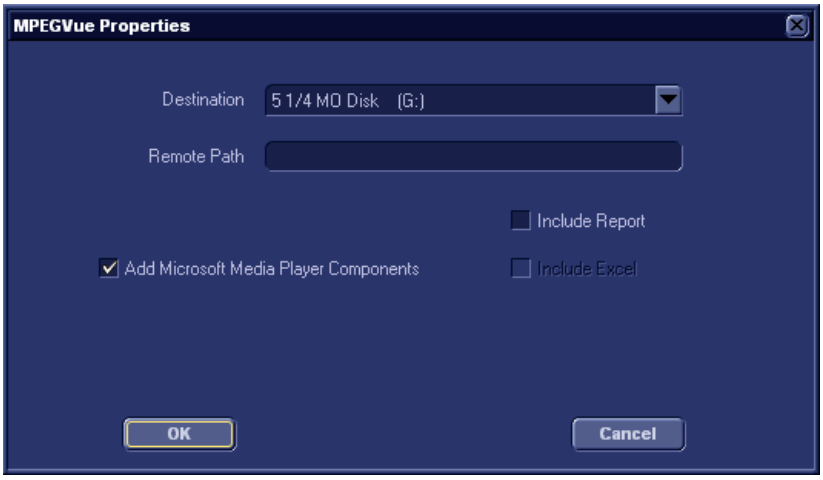


Figure 2-20: The MPEGVue properties window

2. Select a removable media or a network volume remote path as the destination in the *Destination Pull-down menu*.
   Note: Remote paths of network volumes must be entered once in the *Remote path field* before they can be selected from the *Destination Pull-down menu*.
   Note: CD-R/DVD-R is not available in EchoPAC PC Software Only. To create a MPEGvue CD/DVD, select **Internal HD** as destination. When exporting patient records to MPEGvue, the data is stored in *Archive/Export folder*. Copy all the exported files to a CD/DVD. After creating the CD/DVD, delete the files in the *Archive/Export folder*, otherwise its content will be added to the next MPEGvue export.
3. Check the options as required.
4. Select **OK** and **Config** (**F2**).

Importing patient records/examinations

1. Insert the removable media of the source archive in the corresponding drive (MO drive, Zip drive or CD-ROM).
2. Press **Archive**.
   The *Search/Create Patient window* is displayed (see Figure 2-1, page 14).
3. Select destination archive in the *Dataflow field*:
   - **LocalArchive-Int.HD**: imports data to the local archive.
   - **RemoteArch-RemoteHD**: imports data to an Echo server (network) or a Vivid 7 (direct connect).
4. Press **Import** in the *Search/Create Patient window*.
   The *Import dialogue window* is displayed (see Figure 2-21).

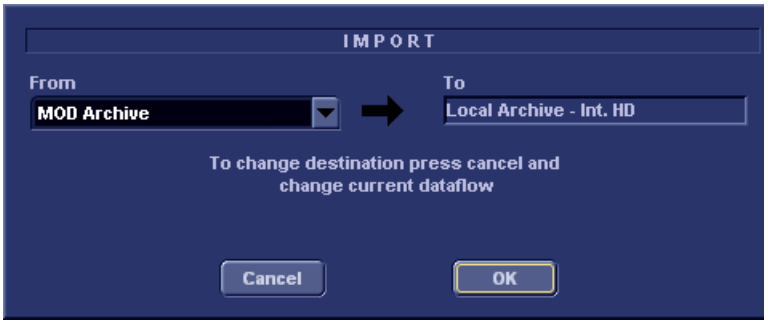


Figure 2-21: The Import Dialogue window

5. Select one of the following available source archive from the *Source drop-down menu*:
   - **MOD Archive**: imports raw and DICOM data (if present) from a MOD.
   - **DICOM MOD 5.25/3.50**: imports DICOM data only from a MOD.
   - **CD/DVD Archive**: imports raw and DICOM data (if present) from a CD-R.
   - **DICOM CD/DVD**: imports DICOM data only from a CD-R.
   - **Remote Import/Export Archive**: imports raw and DICOM (if present) data from an Echo server (network) or EchoPAC PC (direct connect or network).

- **Query retrieve**: imports data from a DICOM server.

6. Press **OK**.
   The *Import patient window* is displayed (see Figure 2-22).

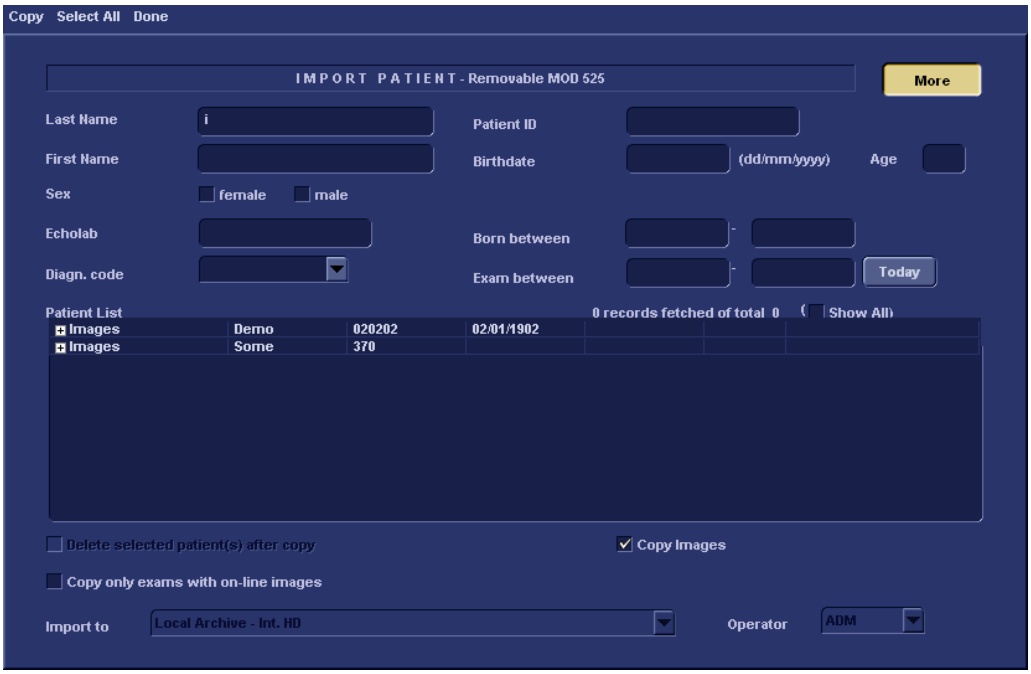


Figure 2-22: The Import patient window

7. Search and Select the patient records to import in the *Patient list*.
   The following selection methods can be used:
   - Press and hold down **SHIFT** while selecting patient records/examinations to select several consecutive items at a time.
   - Press and hold down **CTRL** while selecting patient records/examinations to select several discrete items.
   - Press **Select all** in the *Import patient window* to export all patient records.
   - Press **Today** to display today's examinations and select the actual examinations.

- Fill out the *Exam between field* to display the patient records done during a specific time period and select the actual records.
- Fill out the *Born between field* to display the patient records of patients born during a specific time period and select the actual records.

8. Adjust the following settings (if available) as desired:
   - **Copy images**
9. Press **Copy**.
   If one or more patient examination is already present in the destination archive the *Export/Import conflict window* is displayed (see Figure 2-16). For each conflicting item, select:
   Keep: to keep the existing examination in the destination archive.
   Replace: to replace the existing examination with the corresponding item in the source archive.

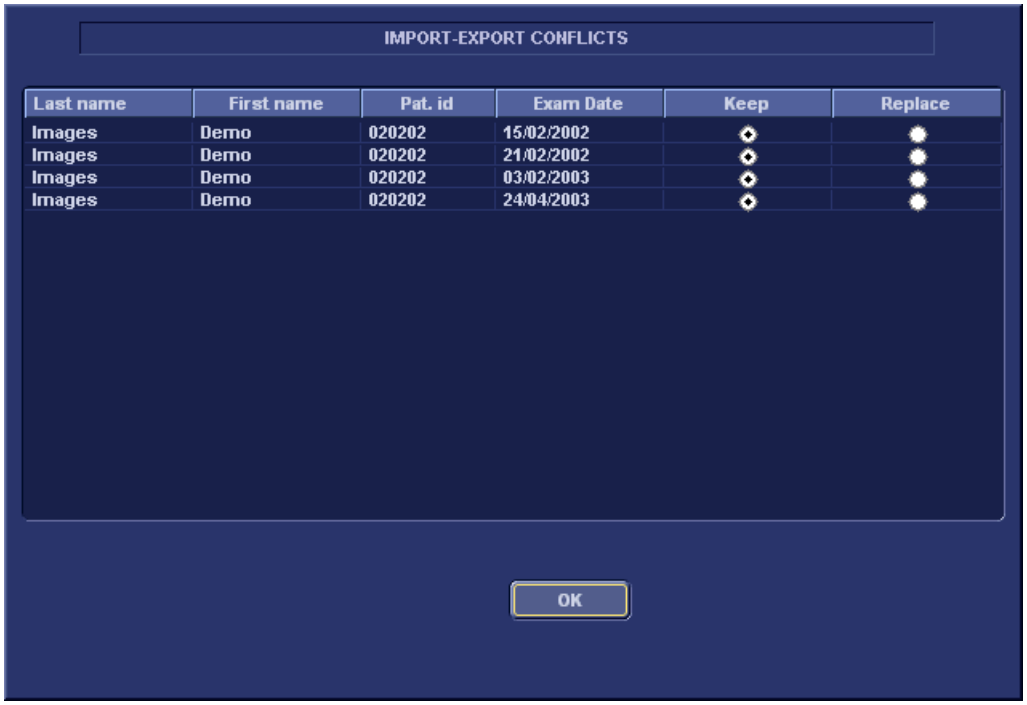


Figure 2-23: The Export/Import conflict window

Press **OK** to resume import.
A progress indicator is displayed. When done a status window is displayed showing the number of patient records that have been successfully imported.

10. Press **OK**.
    A check mark is displayed in the *Copied field* in the *Import patient window* for each item imported.
    A status message is displayed for each item imported. Make sure that the operation was successful for each item imported.
11. Press **Done** in the *Import patient window* to complete the process.

Disk management

The Disk management function allows the user to manage hard disk space while maintaining the patient database on the system. The Disk management function can be used to move, copy or delete images and reports from the oldest patient records (configurable). The Disk management function has also an auto-purge feature that will automatically delete images and reports that have already been copied if the local hard disk is getting full.

Note: the auto-purge function is not available on EchoPAC PC Software Only. To prevent the computer hard drive running EchoPAC PC Software Only to fill up, the user can on a regular basis run Disc Management configured as to move the oldest files.

Three different disk management scenarios are possible depending on the system configuration:

When moving or copying files a copy of the patient archive is also created on the media.

- Disk management is set to **move** files: the user runs the Disk management function on a regular basis to move images and reports from older patient records to removable media or to a network volume. Using this setting, moved images and reports are deleted from the local hard drive and copied to the specified destination. This scenario prevents the local disk to fill up and keeps images and reports from the most recent patient records on the local disk. Using this scenario, the user can control what should remain on the system while keeping the disk free space at an operational level.
- Disk management is set to **copy** files: the user runs the Disk management function on a regular basis to copy images and reports from older patient records to removable media or to a network volume. To prevent the local disk to fill up, the auto-purge function automatically deletes files that were previously copied when the disk free space has reached the minimum allowed limit. This scenario lets the system automatically manage the disk space on the system.

  Note: when using this setting, the images location displayed in the *Examination list screen* will be the selected destination for the copy operation, even if the images are still present on the local hard drive. When

reviewing the exam, the original images will be retrieved from the local hard drive as long as they are available there. When the images are deleted from the local hard drive by the auto-purge function, the copied images will be retrieved.

- Disk management is set to **delete** files: the user runs the Disk management function on a regular basis to delete images and reports from older patient records.

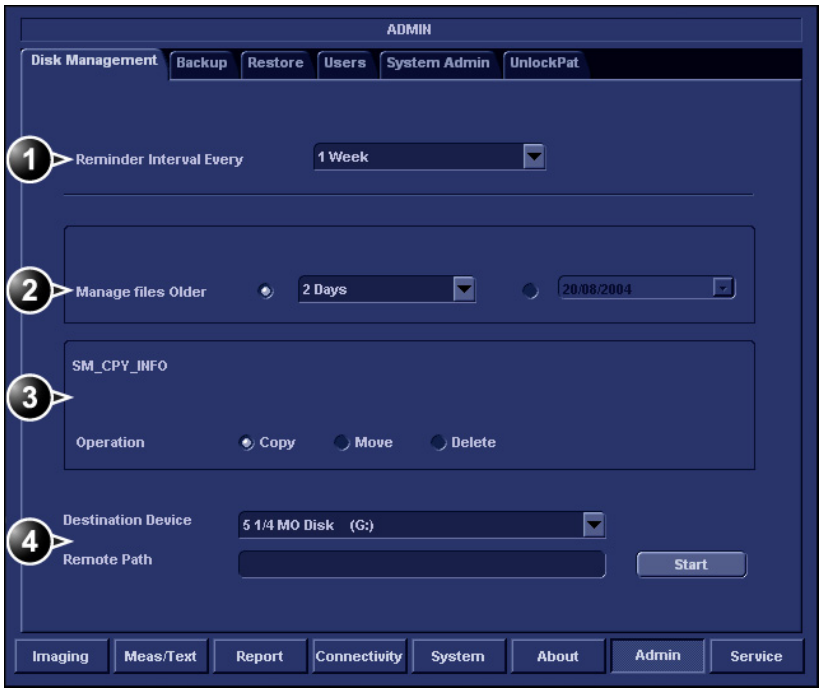
Ensure that you have established a data management protocol for your office/institution. The user MUST manage the removable media used when running Disk management by keeping a log and by creating a media filing system.

A person should be in charge of performing the process. The Disk management system can be set up so that a reminder is displayed at a regular time span.

Configuring the Disk management function

Configuration of the Disk management system can only be done by user with administration rights.

1. Select **Config** (F2).
   If required log on as administrator.
2. Select the category **Admin**.
3. In the *Admin category*, select the sheet **Disk management**.



1. **Sets the reminder time interval for running Disk management.**
2. **Sets the files to be managed based on the examination dates.**
3. **Sets the Disk management to copy, move or delete images.**
4. **Sets the destination device.**

Figure 2-24: The Disk management sheet

Disk management schedule setting

1. Next to **Reminder interval**, specify the number of days/weeks you want the system to prompt you to perform disk management.
   This setting should be set based on the activity of your office/institution. If **None** is selected, no reminder will be displayed.

Data management settings

1. Select a number of days, weeks or months or a specific date next to **Manage files older than**. Only files older than the specified setting will be copied or moved.
   If **none** is selected, all files will be copied or moved.

2. Next to **Operation** check:
   - **Copy**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination. Using this setting, the files will exist in two locations, the local hard drive and the media used to copy to.
   - **Move**: the images and reports from the examinations older than the specified setting defined in step 1 are copied to the specified destination, verified and then deleted from the local hard drive. Using this setting, the files will exist in one location, the media used to move the files to. They are removed from the local hard drive.
   - **Delete**: the images and reports from the examinations older than the specified setting defined in step 1 are deleted from the hard drive.

Destination device setting

1. Next to **Destination device**, select a removable media or a network shared folder.
   Note: to be able to select a network shared folder in the *Destination device field*, its path must have been entered once in the field next to **Remote path**.

△
CAUTION

If using removable media, it is recommended to use dedicated media to the Disk management process. Removable media used for data backup must not be used when performing Disk management.

Do not use the same removable media on several systems.

Running the Disk management function

The Disk management function can be run at any time. In addition, the user may be prompted to run Disk management if the time since the last Disk management operation performed has reached the setting for the Reminder interval (see page 44), or if the local hard drive is about to be full.

Manual start of Disk management

1. Select **Archive**.
   The *Search/Create patient window* is displayed.
2. Select **Disk management**.

The *Disk management welcome screen* is displayed (Figure 2-25).

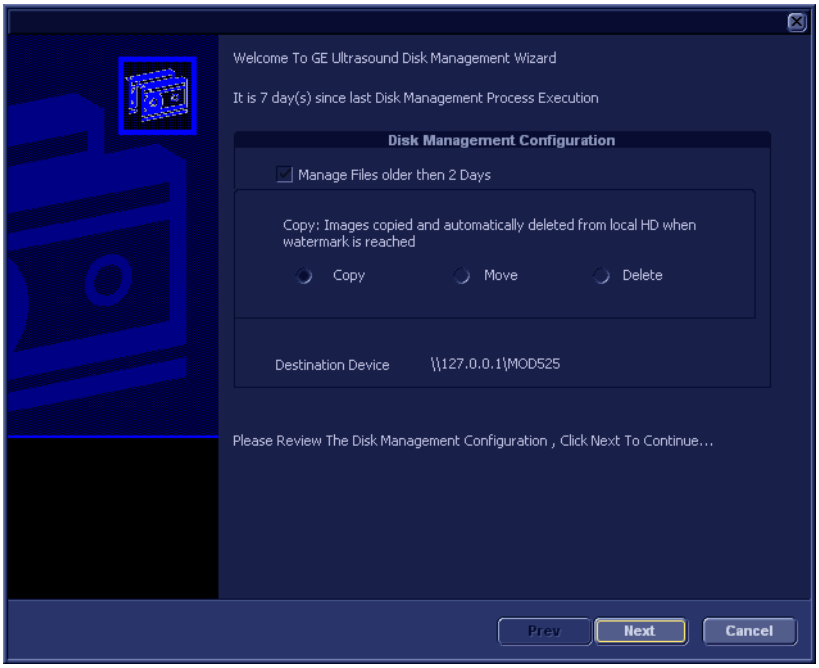

Welcome To GE Ultrasound Disk Management Wizard
It is 7 day(s) since last Disk Management Process Execution
Disk Management Configuration
Manage Files older then 2 Days
Copy: Images copied and automatically deleted from local HD when watermark is reached
Copy
Move
Delete
Destination Device
\\127.0.0.1\MOD525
Please Review The Disk Management Configuration , Click Next To Continue...
Prev
Next
Cancel

Figure 2-25: The Disk management welcome screen

The Disk management operation will either copy, remove or delete files from the local archives depending on the Disk management configuration (see page 43). Make sure that the correct configuration is set.

3. Press **Next**.
   The *Storage size information window* is displayed (Figure 2-26).
   Verify the information displayed. If using removable media, the operation may require several media as specified on the screen. Make sure to gather the necessary number of disks.

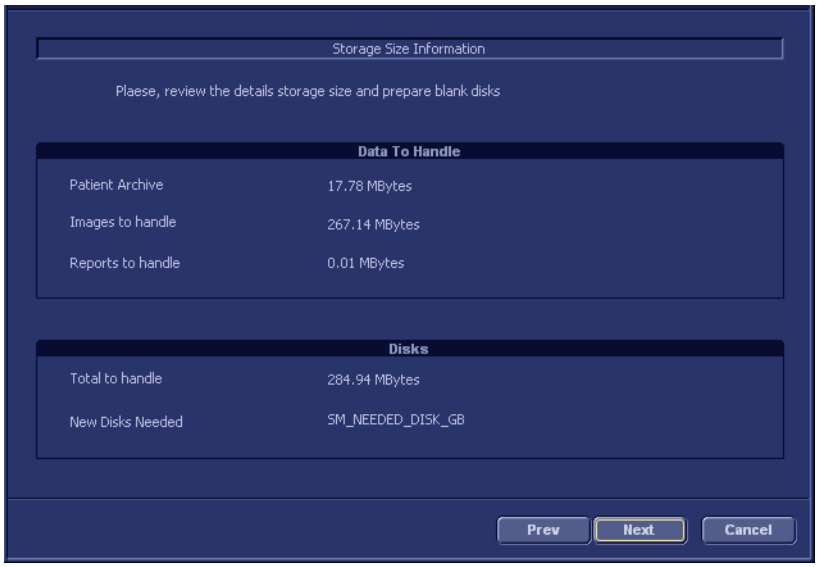


Figure 2-26: The Storage size information window

4. Insert a removable media in the specified drive.
   The disk does not need to be formatted.
5. Press **Next**.
   The *Copying files window* is displayed (Figure 2-27).

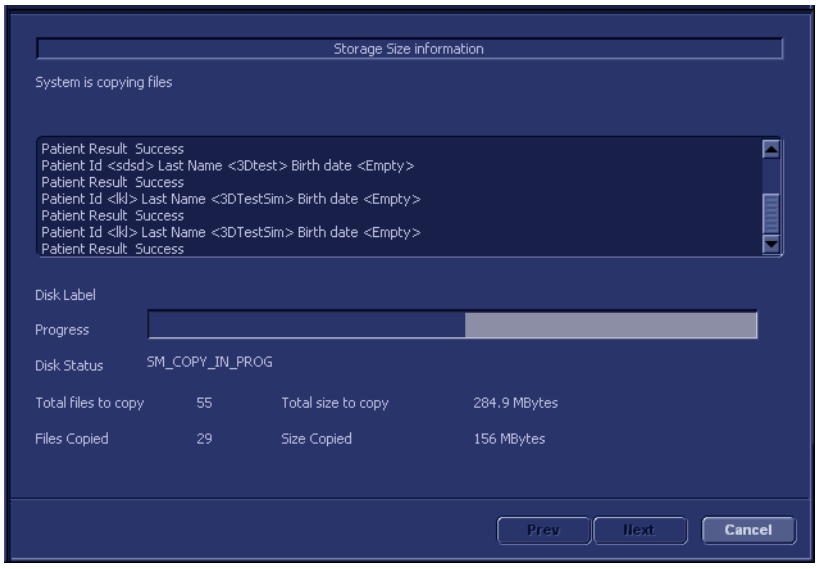


Figure 2-27: The Copying files window

The system automatically formats and labels new disks. If the media contains backup or export data, a Warning window is displayed.
Select between:

- **Cancel**: the Disk management process is stopped.
- **Eject**: the media is ejected, a new media must be inserted to resume the Disk management process.
- **OK**: (Export disk only) the export data on the disk is deleted and the Disk management process is resumed. This choice is not available if the disk contains backup data.

The information displayed on the *Copying files window* is updated while the files are being copied.

6. If more than one media is necessary the filled media is ejected and a dialogue window is displayed asking the user to label the ejected disk and insert a new media.
   Press **OK** after the new media is inserted.
   The operation is resumed.
   When all the files are copied, the media is automatically ejected.
7. Press **Next** to continue.

The *Summary window* is displayed (Figure 2-28), showing a list of the disks used.

- Select **Print summary** to print the list for archiving purpose.
- Select **Detailed summary** to display the list of the patient records copied.

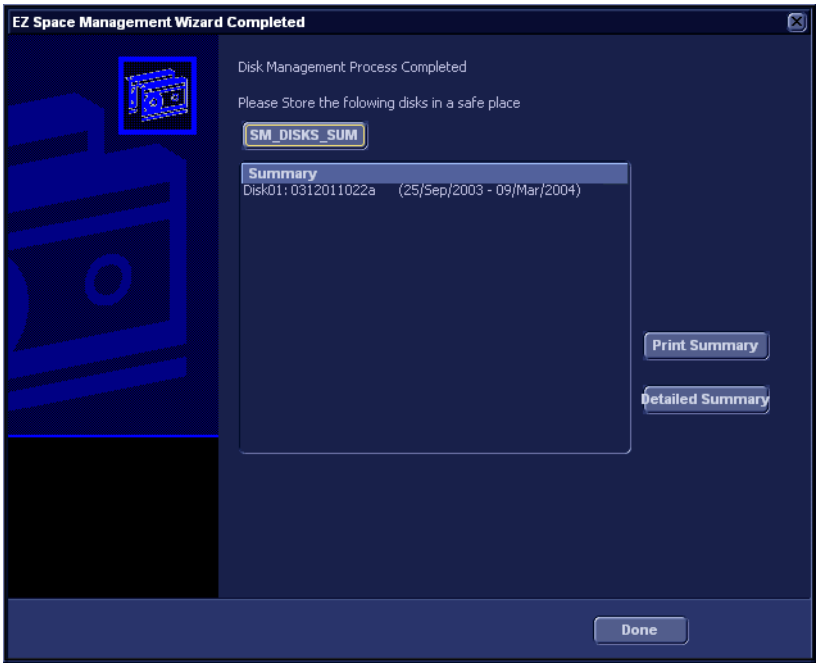


Figure 2-28: The Summary window

8. Make sure that all media are physically labelled according to the list displayed in the *Summary window*. The media label should also have an identification of the system the Disk management was run from.
9. Press **Done** to complete the Disk management operation and file the media.

Data Backup and restore

The Backup/Restore function enables the user to:

- Copy/Restore the patient archive.
- Copy/Restore the system configuration. The Copy/Restore system configuration feature enables the user to configure several units with identical presets, providing that the units have the same software version.

To minimize accidental loss of data, perform backup of the patient archive stored on the local harddrive at least **once a week**.

WARNING

GE Medical Systems is not responsible for lost data if the suggested backup procedures are not followed and will not aid in the recovery of lost data.

There is no backup function for the images or reports (no creation of a safety copy). For long-term storage, images and reports should be moved to removable MOD or to a network shared folder using the Disk management procedure (see page 42).

The backup of the patient archive on the harddrive and the system configuration is done from the configuration management package as described on page 51.

Data from Backup/Restore disks may be restored to the local harddrive using the Restore procedure as described on page 58.

Only users with administration rights have access to the backup/Restore function.

Backup procedure

1. Press **ARCHIVE**.
   The *Operator login window* is displayed.
2. Select the operator with administration rights, enter the password and press **Log on**.
   The *Search/Create patient window* is displayed.
3. In the *Search/Create patient window*, select the dataflow **Local Archive - Int. HD**.

Figure 2-29: Dataflow selection for backup

4. Press **CONFIG** (**F2**).
5. Select the category **Admin**.
6. Select the **Backup** sheet.

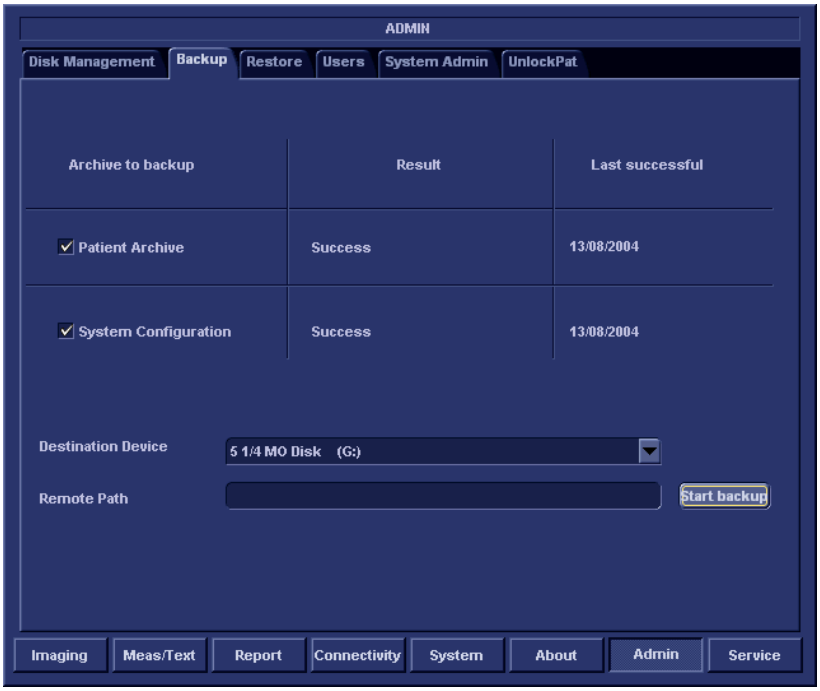


Figure 2-30: The Backup sheet

7. In the *Backup sheet* select as needed:

- **Patient archive** to backup the patient records.
- **System configuration** to copy system settings and user presets.

8. Select a removable media or a shared network folder as destination.
   Note: to be able to select a shared network folder, the path (of type: \\server-name\share-name) must be entered once in the *Remote path field*.
9. If the backup is done to a removable media, insert a dedicated media in the drive.
10. Select **Start backup**.
    The following situations may occur:
    - The system is checking that the removable media is inserted. If not, a dialogue window is displayed prompting the user to insert a media.

Figure 2-31: The Insert media window

Insert the media and select **OK**.

- The system is checking if the media needs to be formatted. If yes, the media is automatically formatted. An *Information window* is displayed showing the media label.

Figure 2-32: The Information window

Write down the label and select **OK**.

- The system is checking if there is already a backup or a Disk management copy on the media. If the following error message is displayed, the disk is ejected and the user is asked to use a new media that does not contain any backup or Disk management data.

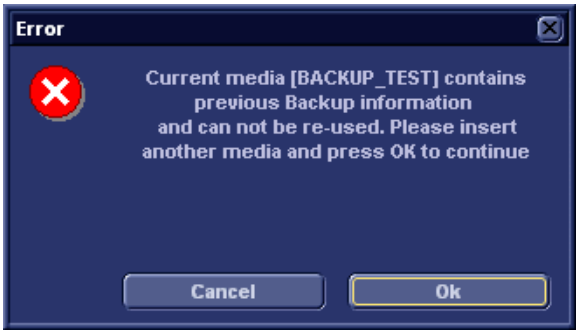


Figure 2-33: The Replace current media window

Insert a new media and select **OK**.

Note: to reuse a Backup media when performing a new archive backup, the media has to be re-formatted first.

11. During backup, *Progress windows* are displayed showing the current operation being performed.

Figure 2-34: The Backup progress windows

12. At the end of the process, the media is ejected and the *Backup completed window* is displayed.

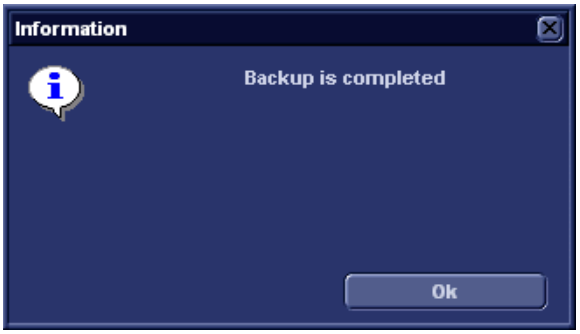


Figure 2-35: The Backup completed window

Select **OK**.
The Backup result is displayed on the *Backup sheet*.

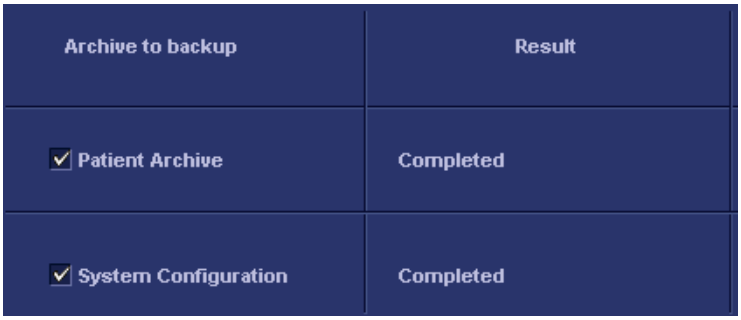


Figure 2-36: The Backup result

13. Make sure to physically label the media. An identification of the system should also be noted on the media and a backup log should be kept.
File the media in a safe place.

Backup procedure for EchoPAC PC Software Only

If the PC running EchoPAC PC Software Only has a MO drive connected, data backup may be performed using the Backup function that is part of EchoPAC PC Software Only (see ’Backup procedure’ on page 51).

If there is no MO drive connected to the PC running EchoPAC PC Software Only, a third-party backup tool may be

used or the necessary files and folders may be copied. Follow the procedure below to ensure that data is preserved.

Backup procedure for EchoPAC PC Software Only using a third-party backup tool

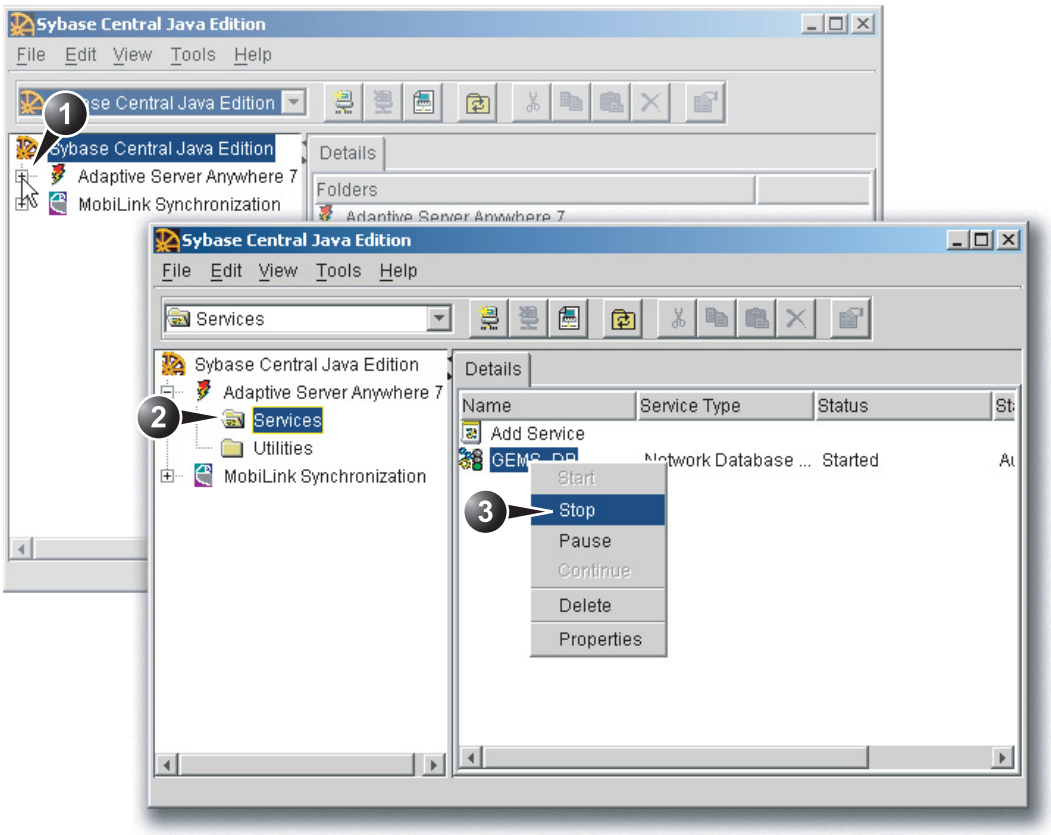
You may use a third-party backup tool or perform a file copy operation to backup the patient data and user-defined system presets on EchoPAC PC.

Before taking a backup the database service must be stopped.

Stopping the database service

1. Close EchoPAC PC if running.
2. From Windows **Start** menu select **Programs** -> **Sybase SQL Anywhere 7** -> **Sybase Central 4.0**.
   Sybase Central is starting.
3. In Sybase Central expand the folder **Adaptive Server Anywhere 7** and select the folder **Services**.
4. Right-click on the service **GEMS_DB** and select **Stop**.

*To restart the database service after backup, select **Start** or restart the PC.*



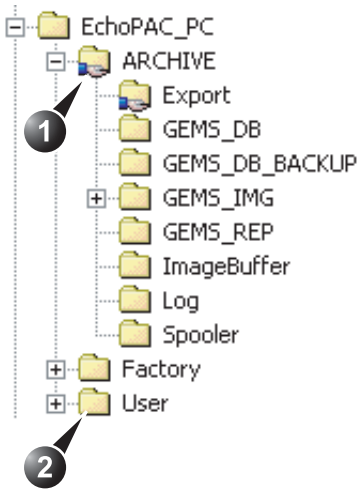
1. **Expand Adaptive Server Anywhere 7.**
2. **Select Services folder.**
3. **Right-click GEMS_DB and select Stop.**

Figure 2-37: Stopping the database service

Files to backup

All the EchoPAC PC patient data is contained within the folder that is shared as “Archive”. Unless otherwise specified during the installation, the default location is: C:\EchoPAC_PC\ARCHIVE (see Figure 2-38).

The user-defined presets are contained within the folder C:\EchoPAC_PC\User.



1. **Archive folder: contains patient data**
2. **User folder: contains the user-defined presets**

Figure 2-38: The EchoPAC PC file structure

1. Take a backup of the **Archive** folder to backup the patient database, the image archive and the report archive.
2. Take a backup of the **User** folder to backup the user-defined presets.
3. To restart the database service after backup is complete, right-click on the service **GEMS_DB** in Sybase Central and select **Start** (see Figure 2-37) or restart the PC.

Restore procedure

1. Press **CONFIG** (**F2**).
2. Select the category **Admin**.
3. Select the **Restore** sheet.

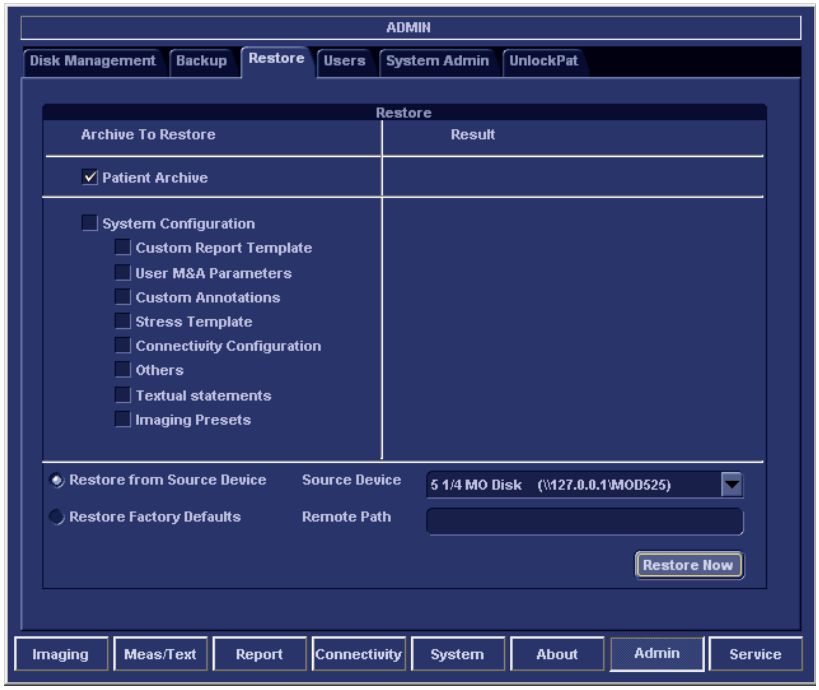


Figure 2-39: The Restore sheet

4. In the *Restore sheet* select as needed:
   - **Patient archive** to restore the patient archive.
   - **System configuration** to restore all system settings and user presets.

     OR
   - One or several **system configuration items** to restore parts of the system settings and user presets (see Figure 2-39).
5. Make sure that **Restore from Source Device** is selected.
6. Select the appropriate **Source device**.

△
CAUTION

The Restore procedure will OVERWRITE the existing data on the local harddrive. Make sure to select the correct source device.

7. If restore is done from a backup on a removable media, insert the media in the drive.

△
CAUTION

The Restore procedure will OVERWRITE the existing data on the local harddrive. Make sure to insert the correct media.

8. Select **Restore now**.
   Depending on the selection, one or two *Restore confirmation windows* are displayed:

Warning
Would you like to replace current Patient Archive with backed up from \\127.0.0.1\MOD525\ ?
Ok
Cancel
Warning
Are you sure you want to replace current system setting with setting from G:\ ?
Ok
Cancel

Figure 2-40: The Restore confirmation window

9. Ensure that the correct source is selected an select **OK**.
   The selected items are copied to the systems. If items from the system configuration are restored the system needs to be rebooted. The *Reboot system window* is displayed.

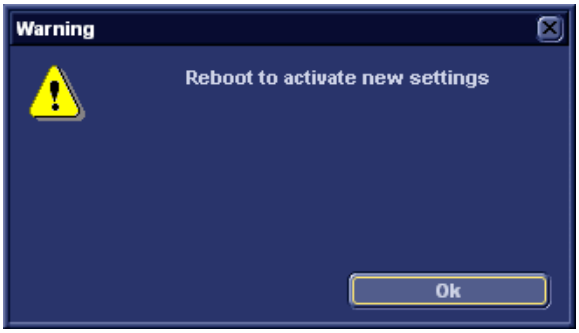


Figure 2-41: The Reboot system window

10. Select **OK** to reboot the system.

Restore procedure for EchoPAC PC Software Only

If the PC running EchoPAC PC Software Only has a MO drive connected, data restore may be performed using the Restore function that is part of EchoPAC PC Software Only (see 'Restore procedure' on page 58).

If there is no MO drive connected to the PC running EchoPAC PC Software Only, a third-party restore tool may be used or the necessary files and folders may be copied back to EchoPAC PC. Follow the procedure below to ensure that data is preserved.

Restore procedure for EchoPAC PC Software Only using a third-party restore tool

You may use a third-party backup tool or perform a file copy operation to backup the patient data and user-defined system presets on EchoPAC PC.

1. Before restoring data the database service must be stopped as described in ’Stopping the database service’ on page 55.
2. Restore the **Archive** folder to restore the patient database, the image archive and the report archive.
3. Restore the **User** folder to restore the user-defined presets.
4. To restart the database service after restore is complete, right-click on the service **GEMS_DB** in Sybase Central and select **Start** (see Figure 2-37, page 56) or restart the PC.

Server options

EchoPAC Share

EchoPAC Share is an option that enables the EchoPAC PC workstation to be used as a server for up to three different GE clients.

The following GE devices can be connected:

- Vivid 7 (v. 2.x or higher)
- Vivid 4 (v. 3.x or higher)
- Vivid 3 (v. 3.x or higher)
- Vivid i
- EchoPAC PC (Turnkey or Software Only, v. 4.x or higher)

The GE clients connect directly via proprietary protocol to EchoPAC PC for both storage and retrieval of patient and image data. Without the option EchoPAC Share, only one single GE client can be connected to the workstation.

EchoPAC DICOM Share

EchoPAC DICOM Share is an option that enables non-GE ultrasound scanners to store images to EchoPAC PC over a network connection via DICOM protocol. I.e. EchoPAC PC acts as a DICOM server (DICOM Storage SCP). Up to two non-GE clients and one GE client can be connected simultaneously.

EchoPAC DICOM Share setup

When the EchoPAC DICOM Share option is enabled a dedicated configuration sheet is available in Config. EchoPAC DICOM Share setup consists of:

- DICOM parameters setup for EchoPAC PC
- Non-GE clients registration

DICOM parameters settings

1. Press **Config** (F2).
2. Select **Server Config**.
   The *Server configuration window* is displayed.

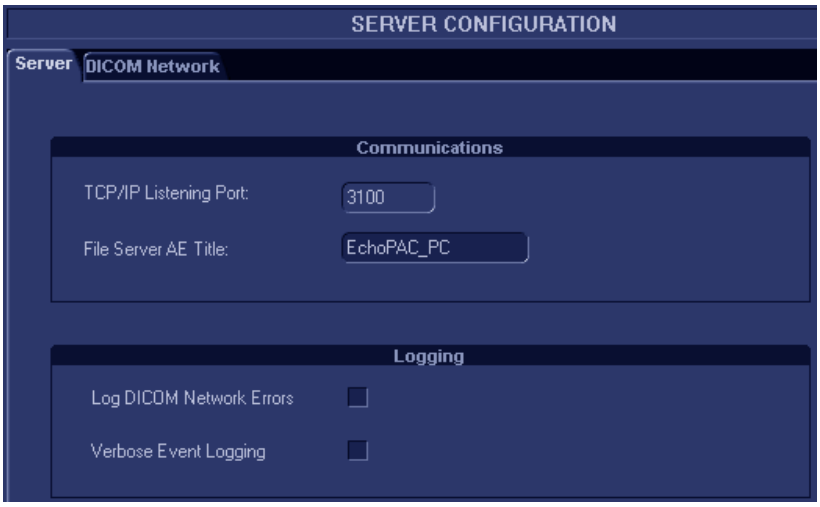


Figure 2-42: Server configuration window

3. In the *Server sheet*, enter the **File server AE Title**. The default AE Title is **EchoPAC_PC**.
   The **TCP/IP listening port** is pre-configured (**3100**).
   If required activate the log functions.
   Note: if the **File server AE Title** is changed the user is prompted to restart the system. Select **OK** and restart he system.

Client registration

1. In the *Server configuration window*, select the **DICOM network** tab.
   The *DICOM network sheet* is displayed.

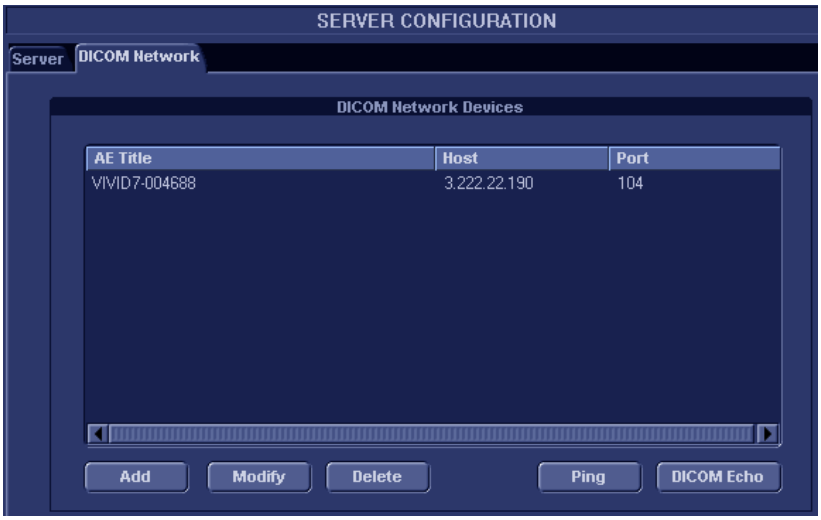


Figure 2-43: DICOM network sheet

2. Select **Add**.
   The *Add/Modify DICOM device window* is displayed.

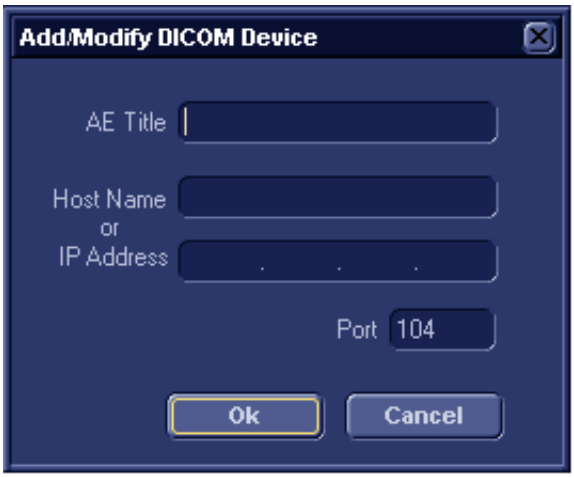


Figure 2-44: Add/Modify DICOM device window

3. Enter the following information:
   - The client **AE Title**
   - The client **Host name** or **IP address**
   - The **Port number** (default is **104**)
4. Select **OK**.
5. Check the connection using **Ping** and **DICOM Echo**.

6. Press **Config** (F2) to exit Config and apply the changes.

Chapter 3
Image Management

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Introduction

EchoPAC PC allows post-processing of DICOM ultrasound images and raw data images from GE ultrasound scanners.

The user selects the images to analyze from the *Image browser screen* (displays a thumbnail overview of all stored images sorted by examination for the current patient) or from the *Review screen* (displays all images for the current examination) or from the *Protocol screen* for examinations based on protocol studies.

The main features of the EchoPAC PC image analysis package are:

- **Image optimization**: adjusts image settings such as Compress, Reject, Tissue priority, zooming, image rotation, cineloop replay adjustment...etc.
- **Measurement and Analysis**: performs either single measurement with post-assignment or protocol based pre-assigned measurements (see Chapter 4, 'Measurements and Analysis' on page 103).
- **Review and analyze protocol studies** such as Stress echo examinations including quantitative stress echo analysis (see Chapter 5, 'Stress echo analysis' on page 177).
- **Quantitative analysis** of Tissue Velocity, Tissue Tracking and contrast imaging data (see Chapter 6, 'Quantitative Analysis' on page 201).

Image review

Images can be reviewed from the *Image browser screen* or from the *Images review screen*.

- The *Image browser screen* displays a thumbnail overview of all stored images sorted by examination session for the current patient.
- The *Image review screen* displays all images for the current examination.

Review from the Image browser screen

The procedure described below enables the analysis of images belonging to different examinations for a selected patient record. If images are stored on multiple removable media, they have to be restored to the local hard drive prior to review as described below.

1. In the *Examination list window*, press **Image list** or the **Image browser** menu button.
   The *Image browser screen* is displayed (see Figure 3-3) showing thumbnails of stored images for the current patient sorted by examination sessions.
   If the images are stored on a removable media that is not mounted, the image thumbnail is replaced by a symbol.
2. Move the **Mouse cursor** over a thumbnail to display a preview of the image.
3. Select the images to review or press **Analyze** to review all images.
   - If all images are available the images are displayed for review.
   - If some of the images are not available locally the *Restore images window* is displayed.

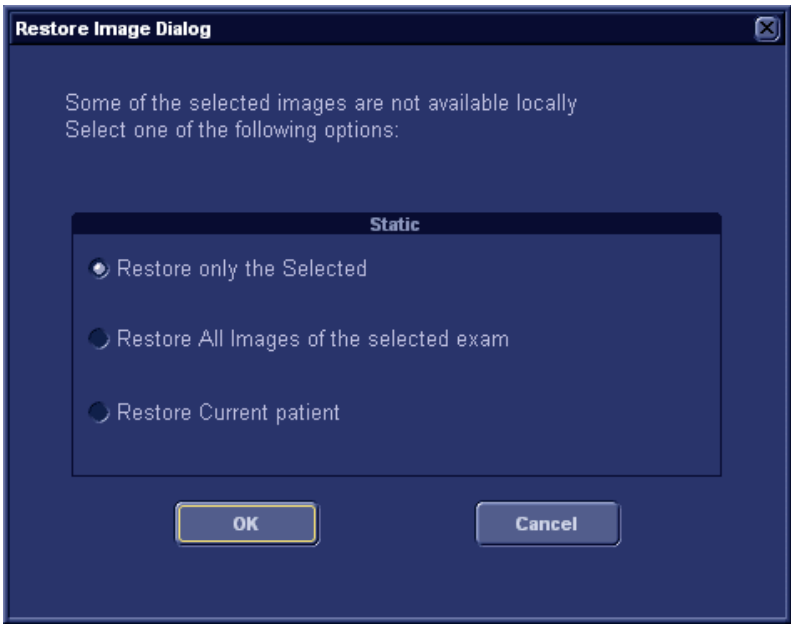


Figure 3-1: The Restore images window

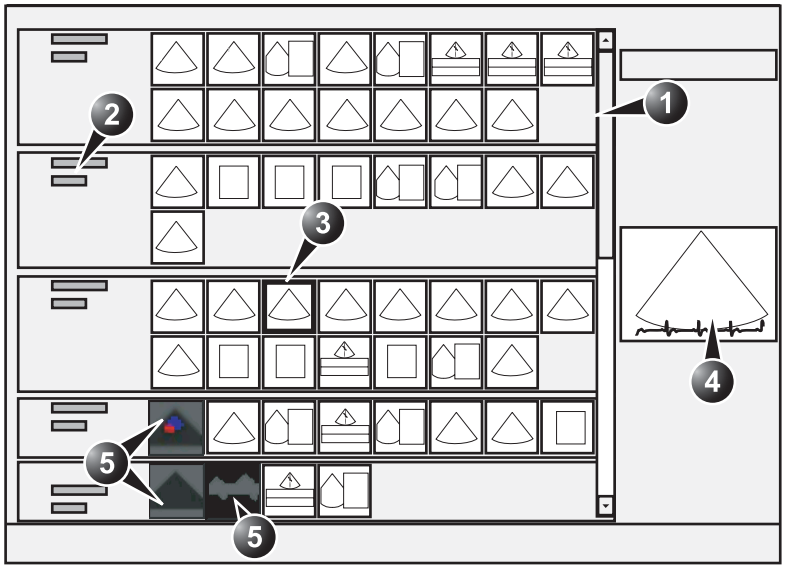
4. Select between:
   - **Restore only the selected images**: only selected images that are not available locally are restored.
   - **Restore all images of the selected exam**: all images that are not available locally in the exams where an image was selected are restored.
   - **Restore current patient**: restores all images in all examinations.
5. Press **OK**.
   The *Insert media window* is displayed.

Dialog
Insert the storage media labeled - TEST
Press OK to continue, or Cancel to abort
If the required storage media is not available press Skip Media
OK
Skip Media
Cancel

Figure 3-2: The Insert media window

6. Insert the required media.
7. Select between:
   - **OK**: the images on the mounted media are restored on the local hard drive. If not all the required images are on the inserted media, the user is prompted to insert another media until all required images are restored on the hard drive.
   - **Skip media**: the images stored on the media required are not restored. If not all the required images are on the inserted media, the user is prompted to insert another media until all required images are restored on the hard drive.
   - **Cancel**: no images are restored.

   The selected images are displayed for review.

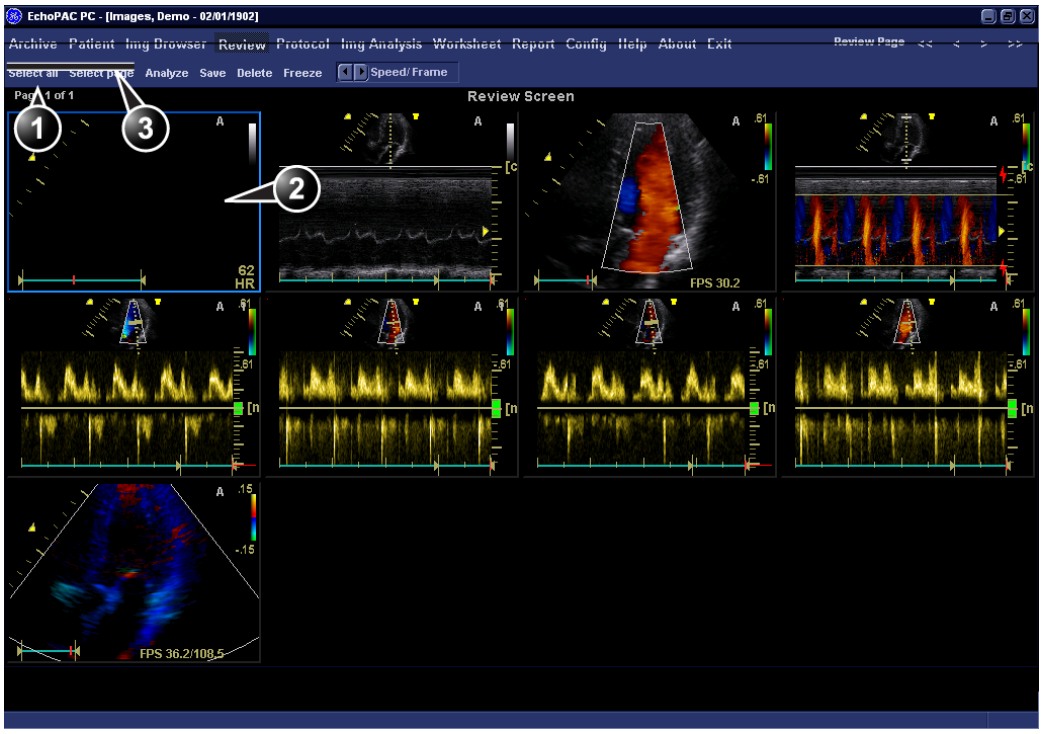


1. **Examination**
2. **Examination date and archive location**
3. **Selected image**
4. **Preview of selected image**
5. **Missing images**

Figure 3-3: The Image browser screen

Review from the Review screen

1. In the *Examination list window*, select an examination and press the **Review** menu button.
   The *Review screen* is displayed showing all images for the current examination (see Figure 3-4).


EchoPAC PC - [Images, Demo - 02/01/1902]
Archive Patient Img Browser Review Protocol Img Analysis Worksheet Report Config Help About Exit
Select all Select page Analyze Save Delete Freeze Speed/ Frame
Review Screen
1
2
3
62 HR
FPS 30.2
FPS 36.2/108.5

1. **Page number**
2. **Selected image (bold frame)**
3. **Selection tools**

Figure 3-4: The Review screen

To delete an image

Images can be deleted from the *Review screen* as described below or from the clipboard as described on page 98.

1. In the *Review screen*, select the images to delete.
2. Press **Delete** in the *Review menu*.
   A pop-up dialog box is displayed asking for confirmation of the deletion.
3. Press **OK** to delete the selected images.

Image optimization

Image optimization is performed in the *Image analysis screen* after selection of the image of interest in the *Image browser screen*, the *Review screen* or the *Protocol screen*.

From the *Image browser screen*, the user can analyze images from different examination sessions for the selected patient.

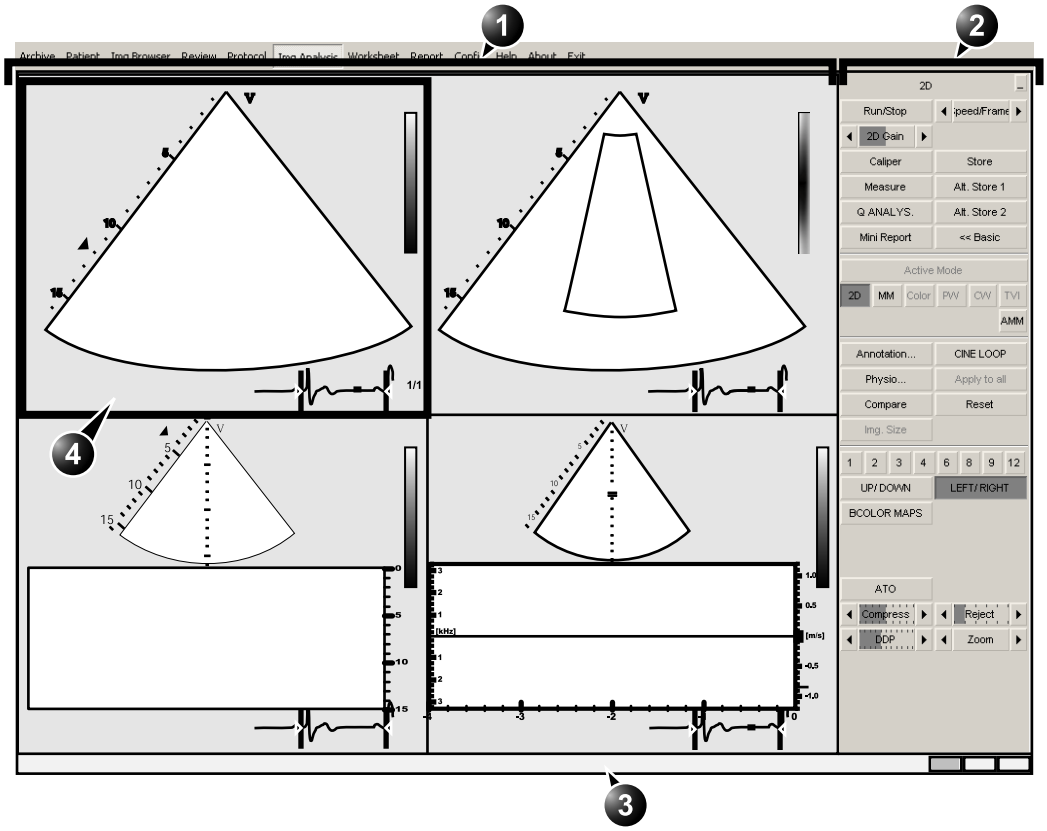
From the *Review screen* the user analyzes images from the currently selected examination.

From the *Protocol screen* the user can analyze images from a stress echo examination.

Image analysis screen overview

The *Image analysis screen* consists of:

- a *Display window* showing up to 12 ultrasound images (single frame and cineloop), see Figure 3-5.
- a Control panel for image optimization and analysis. The control panel is mode-dependent (see Figure 3-6 through Figure 3-10).



1. **Display window**
2. **Control panel**
3. **Status bar**
4. **Selected image (Highlighted frame)**

Figure 3-5: The Analysis screen

Control panel overview

The control panel can be displayed in three states:

- **Minimized**: displays only a few controls. This setting enables maximum image display area.
- **Basic**: displays a selection of mode specific controls.
- **Advanced**: displays all the mode specific controls.

Control panel display

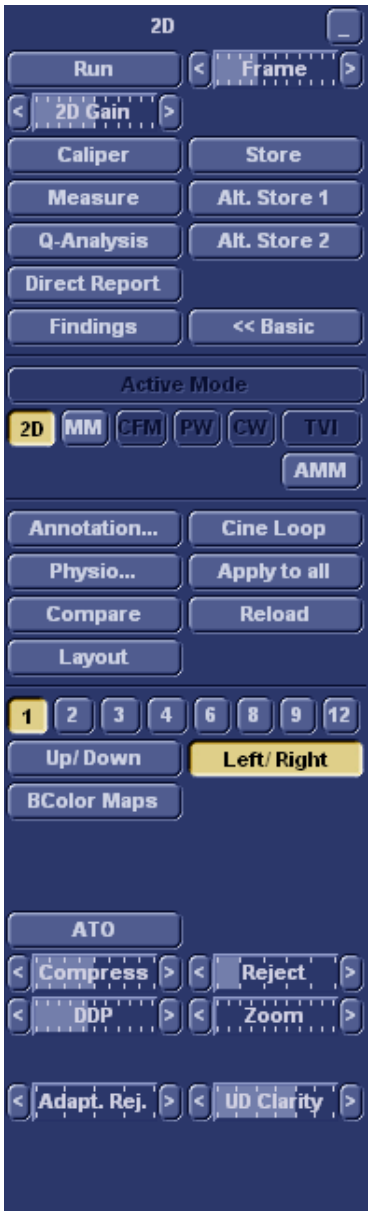
Switch between minimized and basic/advanced display

1. Press the button on the upper left corner of the control panel.

Switch between basic and advanced display

1. When the advanced control panel is displayed, press **<< Basic**
   When the basic control panel is displayed, press **Advanced >>**.

Advanced



Basic

Minimized

Figure 3-6: The 2D control panel

Advanced

Basic

Minimized

Figure 3-7: The M-Mode control panel

Advanced

Basic

Minimized

Figure 3-8: The 2D Color control panel

Advanced

Basic

Minimized

Figure 3-9: The M-Mode Color control panel

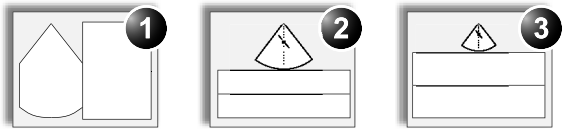
Advanced

Basic

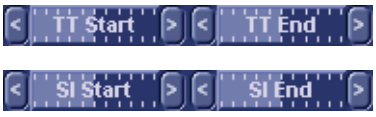
Minimized

Figure 3-10: The Doppler Spectrum control panel

Control	Description
	Run/Stop Cineloop (All modes): Starts and stops the cineloop (shortcut: **ALT** + **R** or **SPACE BAR**). When running, use **Speed/Frame** to adjust the cine speed. When stopped, use **Speed/Frame** to scroll through the cineloop. **2D Gain (All modes):** Tissue gain **Gain (All modes but 2D):** Gain for the active mode. **Caliper (All modes):** Activates measurement tool (unassigned measurement). **Measure (All modes):** Activates the Measurement & Analysis (M&A) calculation program (protocol based pre-assigned measurements). **Quantitative Analysis (2D, 2D Color):** Starts the Quantitative analysis program for TVI and contrast applications (see page 201). **Direct report (All modes):** Displays the Direct report where the user can enter comments, diagnosis and Ref. reason information while doing image analysis. The Direct report displays also an overview of the measurements performed. **Store (All modes):** Stores the currently active image to disk. **Alt. Store 1 and 2 (All modes):** Stores the image to an alternative media. This function is configurable. **Basic/Advanced:** Displays the basic or advanced control panel.

Control	Description
	Active mode (Color, M-Mode, Doppler): In combined mode, switches between modes to activate the mode specific controls. **Mode selection (All modes):** In combined mode, select the mode to display. **Annotation:** Enables the insertion/deletion of body marks, arrows and text in the selected image. **Physio:** Enables to display/hide and adjust the physiological traces. **Compare (All modes):** Displays a copy of the selected cineloop. Enables frame by frame comparison of the selected cineloop (independent scrolling). **Image size (Doppler, M-Mode):** Toggles the display priority of 2D Mode or Doppler/M-Mode and top/bottom (1) or side by side display with 2D priority (2) or time-motion priority (3) when working in combined mode.  **Cineloop:** Displays the cineloop controls (see (page 86)). **Apply to All (All modes):** Applies changes on all opened images. Works for the following controls: Up/Down, Left/Right, Invert, Variance, Persistence, Tissue priority, Gain, Compress, Reject, Baseline, Mode selection and Color Map. **Reset (All modes):** Restore all controls to original setting.

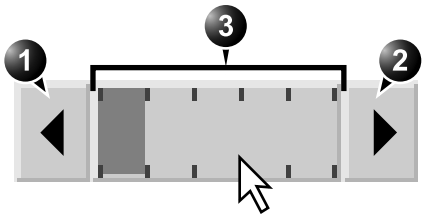
Control	Description
	1 to 12: Select the number of images to display. **Up/down (2D, 2D Color, M-Mode):** Flips the image 180 degrees. **Map (All modes):** Selects mode specific color map from the pop-up menu. **Variance (2D Color):** Controls the amount of variance data added to a color display. Variance enables computer-aided detection of turbulent flow (e.g. jets or regurgitation). **Left/Right (2D, 2D Color):** Creates a mirror image of the original image. The left/right reference marker **V** moves to the other side of the image. **Invert (2D Color, Doppler):** Enables the color scheme assigned to positive and negative velocities to be inverted. **Invert (TSI)** Invert is available for TEE acquisitions. When applied, the time to peak negative velocity is calculated (instead of the time to peak positive velocity). Invert makes it possible to use TSI on TEE acquisitions where the image sector is inverted. **Simultaneous (2D Color, TVI modes):** Enables simultaneous display of 2D image and color image.
	Compress (All modes): Controls the amount of contrast.
	DDP (2D, 2D Color): Performs temporal processing which reduces random noise without affecting the motion of significant tissue structures.
	Reject (All modes): Discards low levels echoes when increased.

Control	Description
	Adaptive reject (2D): Reduces near field haze and blood pool artifact without diluting tissue appearance of moving structures.
	UD Clarity (2D): Enables the user to create a personalized appearance of the tissue. Moving the paddle to the left creates a smoother image, though keeping boundaries sharp. Moving the paddle to the right creates a crisper image.
	Zoom (All modes): Magnifies the image display in both frozen and live (see page 86).
	Horizontal sweep (M-Mode, Doppler): Controls the time scale in the time-motion display.
	Tissue priority (2D Color): Emphasize either the color of the color mode or the greyscale tissue detail of the 2D image.
	Angle Correct. (Doppler): Enables stepwise angle correction (by 2 degrees) of the Doppler velocity scale.
	Transparency (All TVI modes): Controls the degree of transparency of the color display.
	Threshold (All TVI modes): Controls the level of greyscale intensity that is used as a threshold for color.
	**TT Start (Tissue Tracking), Strain Start (Strain):** The time after ECG R-peak when the mode specific calculation starts. **TT End (Tissue Tracking), Strain End (Strain):** The time after Track or Strain End when the mode specific calculation should end.

Control	Description
	TT scale (Tissue Tracking): Controls the color cut-off value of max displacement displayed.
	SI length (Strain rate, Strain): Determines the Strain/Strain rate sample volume size.
	SRI reject (Strain rate), SI reject Adjusts the cut-off level of the low tissue velocity to be discarded. Rejected values are uncolored (Strain) or green (Strain rate).
	Cine compound (All TVI modes): Calculates and displays cineloops generated from a temporal averaging of multiple consecutive heart cycles.
	SI scale (Strain), SRI scale: Define the scale for the color coding for strain or strain rate.
	TSI Cut-off: Controls the cut-off time: using this control it is possible to color all parts of the TSI image that have a time to peak less than a certain cut-off time.

Image controls adjustment

Controls with multiple settings can be adjusted in two ways as shown in (Figure 3-11).



1. **Decrease stepwise**
2. **Increase stepwise**
3. **Select setting on the scale**

Figure 3-11: Image control adjustment

Image optimization

1. Select the **image** of interest.
   The control panel displays the mode specific controls.
2. If necessary display the advanced control panel (see page 74).
3. If applicable, deselect **Run Cineloop** to freeze the image and scroll through the cineloop using the **Speed/Frame** control or by dragging the frame marker on the ECG to display the desired image.
4. In dual modes, press **Image size** until the desired display is shown (see page 81).
   Press **Active mode** to toggle between modes. The control panel is updated accordingly.
5. Adjust the mode specific image controls to optimize the display.
6. Press **Store** to save the changes.

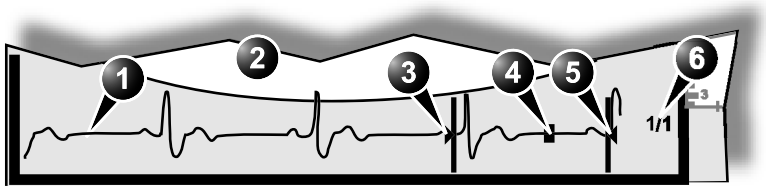
Zoom function

1. Select inside the **Zoom scale** or press the **Zoom increase button**.
   OR
   Press **ARROW UP**.
   A portion of the selected image is magnified and a situation picture is displayed showing the outlined zoom region.
2. Press and hold down the **Left mouse button** while moving the mouse upward to increase magnification or downward to decrease magnification.
   OR
   Press **ARROW UP** to magnify or **ARROW DOWN** to decrease magnification.
3. Press and hold down **SHIFT** and the **Left mouse button** while moving the mouse to move the zoomed area.
   OR
   Press **SHIFT** and **RIGHT ARROW** or **LEFT ARROW**.

Optimizing cineloop

The cineloop boundaries can be adjusted by dragging the left and right markers on the ECG or by using the cineloop controls as described below.

Cineloop overview



1. **ECG**
2. **Loop display**
3. **Left marker: drag to move.**
4. **Current frame: in freeze, drag to select frame or select frame on ECG.**
5. **Right marker: drag to move.**
6. **Cine speed (replay)**

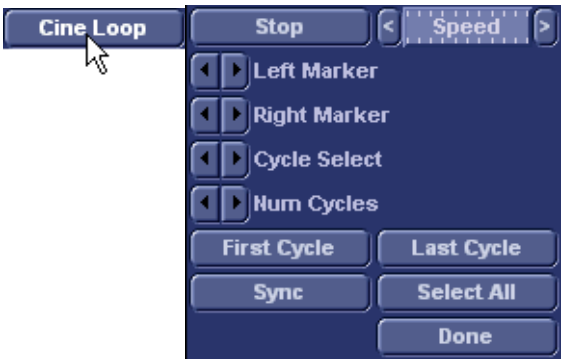


Figure 3-12: The cineloop display and controls

To run/stop a cineloop

1. Press **Run/Stop** or **ALT** + **R** or **SPACE BAR**.

Cineloop adjustment

1. Select a **cineloop**.
2. If necessary, press **Run/Stop** to freeze the cineloop.
3. Press **Cineloop**.
   The cineloop controls are displayed on the control panel (see Figure 3-12).
4. Using the **Cycle select** control, move from heart beat to heart beat to select the heart cycle of interest.

*To jump directly to the first or to the last heart beat press the **First cycle** or **Last cycle** button.*

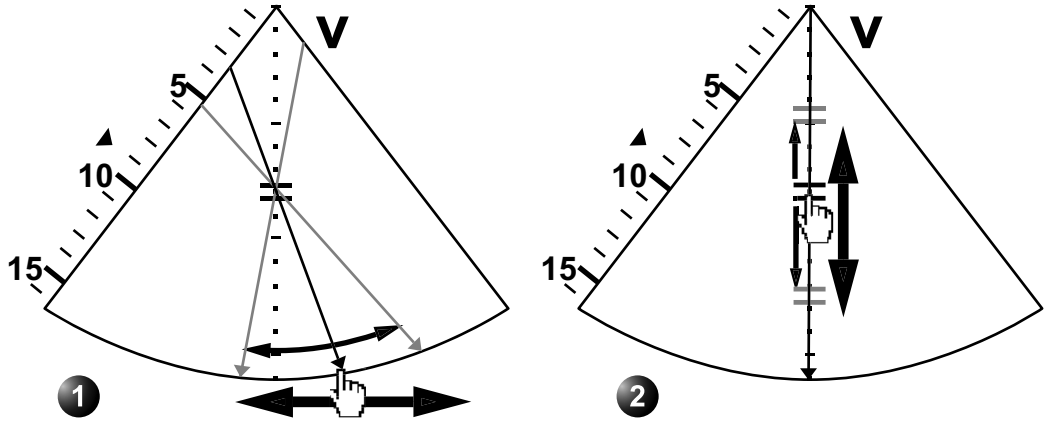
5. Using the **Num cycles**, adjust the number of heart cycle to incorporate to the cineloop.
6. Using the **Left marker** and **Right right** controls, trim or expand the cineloop boundaries.
7. Check **Sync** to synchronize all the cineloop.
8. Press **Done** to return to the *Image Analysis screen*.

Generated Anatomical M-Mode

Anatomical M-Mode (AMM) displays can be generated from raw data 2D, 2D Color and TVI images.

To generate Anatomical M-Mode images

1. In the *Image analysis screen*, select a 2D, 2D Color or TVI image.
2. Select **MM** or **AMM**.
   The *Display window* is updated with an M-Mode image.
   The 2D sector displays a time motion cursor for the AMM.
3. Adjust the AMM cursor position and angle as shown in Figure 3-13.
   All other controls are similar to conventional M-Mode (see page 74 and followings).



1. AMM cursor angle adjustment **2. AMM cursor position adjustment**

Figure 3-13: Adjustment of the AMM cursor

Direct report

Direct report enables the user to write comments during image analysis that will be part of the final report.

Direct report provides also an overview over the measurements completed.

Creating comments

1. Press **Direct report** (see Figure 3-14).
2. Select the comment type.
3. Type your comments in the *Text field*.

1. **Open Direct report**
2. **Select the type of information**
3. **Create/insert pre-defined text**
4. **Text field**
5. **List of measurements completed**
6. **Exits the Direct report**

Figure 3-14: The Direct report

Inserting pre-defined text input

1. Select the insertion point in the *Text field*.
2. Select **Insert text**.

The *Insert text window* is displayed (see Figure 3-15).

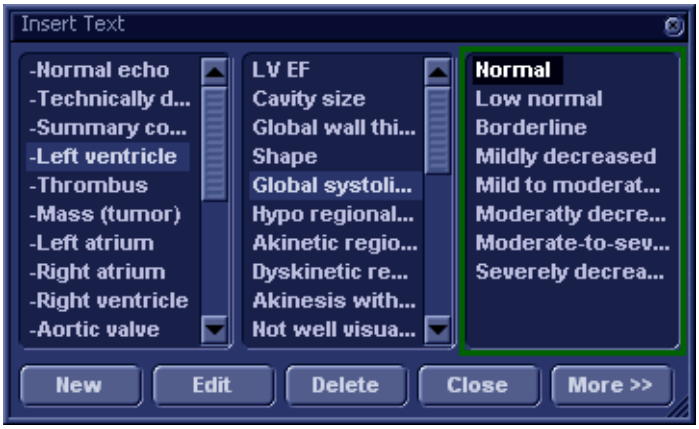


Figure 3-15: The Insert text window

The pre-defined text list is organized in a three level hierarchy. Selecting one item in the first column displays pre-defined text entries related to the selected text in the second and third column.

3. Navigate through the pre-defined text list by selecting items in the columns and double-click on the desired pre-defined text to be inserted. If an entry in the third column is inserted, the selected text in the second column is also inserted. Press **More>>** to display the full text for the selected entry.

Creating pre-defined text input

First level

1. Select the first level.
2. Press **New**.
   The *Enter new text window* is displayed.

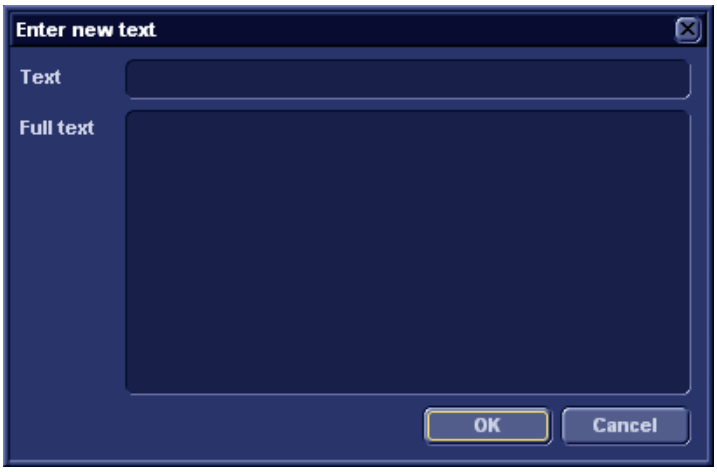


Figure 3-16: The Enter new text window

3. Enter a title in the *Text field*.
   Enter the pre-defined text in the *Full text field*.
4. Press **OK**.

Second and third level

1. Select an item in the first column.
   The pre-defined text input to be created in the second and third column will be related to this selection only.
2. Select the second or third column.
3. Press **New**.
   The *Enter new text window* is displayed (Figure 3-16).
4. Enter a title in the *Text field*.
   Enter the pre-defined text in the *Full text field*.
5. Press **OK**.

Editing a pre-defined text input

1. Select the term to edit in one of the columns.
2. Press **Edit**.
3. The *Edit text window* is displayed.

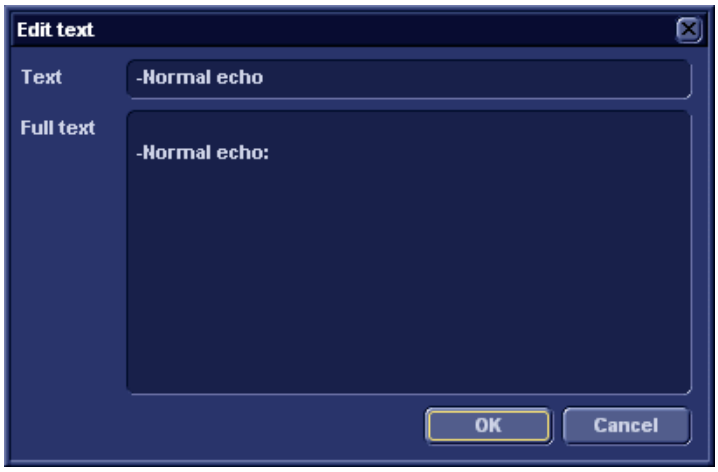


Figure 3-17: The Edit text window

4. Edit the text in both the *Text* and *Full text fields*.
5. Press **OK**.

Deleting a pre-defined text input

1. Select the item to delete in one of the columns.
2. Press **Delete**.
3. A *Confirmation window* is displayed.
4. Press **Yes**.
   The selected text input is deleted including the belonging text inputs.

Saving stored images and cineloops to a standard format

Stored images and cineloops can be saved to removable media or a shared network folder in the following standard formats:

- **Still images**: JPEG, MPEG, DICOM, RawDICOM (Raw data + DICOM) and HDF
- **Cineloops**: AVI, MPEG, DICOM, RawDICOM (Raw data + DICOM) and HDF

Images can also be stored as MPEG format on a CD-R using the Export function as described on page 97.

Procedure

1. In the Image analysis screen. select the required image or loop.
2. Press the **Right mouse button**.
   The *System menu* is displayed.

Figure 3-18: The System menu

3. Select **Save as**.
   The *Save as menu* is displayed.

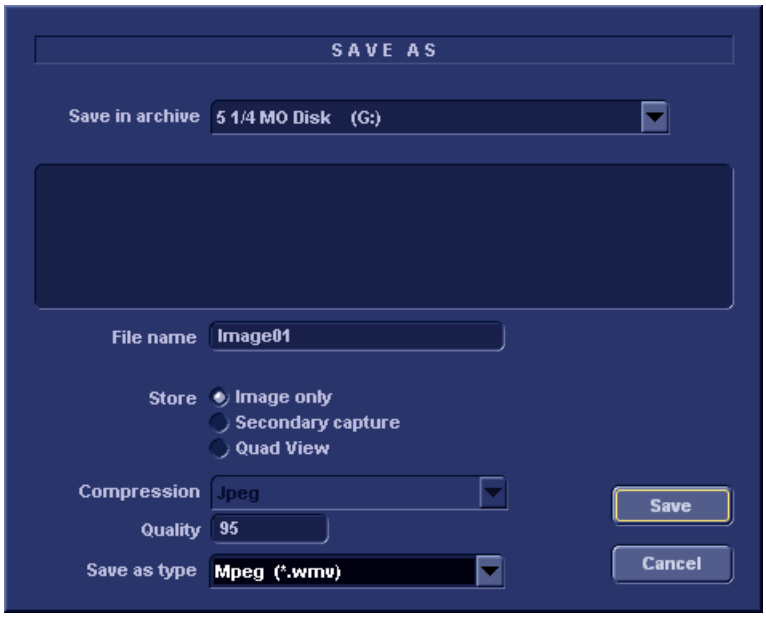


Figure 3-19: The Save as menu

4. Select the desired destination from the *Save in archive pull-down menu*.
5. Enter a file name in the *File name field*.
   If the image or cineloop is saved as DICOM or RawDICOM the file name is automatically generated to follow the DICOM standard.
6. Select between:
   - **Store image only**: saves the image or cineloop only.
   - **Store secondary capture**: creates a still image of the entire screen.

   The secondary capture is not available when saving images as DICOM or RawDICOM.
7. Select the image compression type (JPEG or RIe) or no compression.
8. Enter in the desired **Image quality** (between 10 and 100). A high quality setting will give a lower compression.
9. In the *Save as type field* select one of the following formats:

- **RawDICOM**: saves the still image or cineloop in both GE raw format and DICOM format.
- **DICOM**: saves the still image or cineloop in pure DICOM format.
- **JPEG**: saves a still image in JPEG format.
- **MPEG**: saves the still image or cineloop in MPEG format.
- **AVI**: saves the cineloop in AVI format.
- **HDF**: saves the image or cineloop in HDF (Hierarchical Data Format). HDF is a portable data format for exchange of scientific numerical and graphical data. More information about HDF format at: http://hdf.ncsa.uiuc.edu.

  A tool for viewing HDF files can be downloaded from http://hdf.ncsa.uiuc.edu/hdf-java-html/hdfview/.

10. Press **Save**.
    A file is saved in the selected archive.

MPEGVue/eVue

MPEGvue enables the user to export an exam (images, measurements and reports) into MPEG format readable from a regular Windows computer together with a special MPEG viewer. The measurements performed during the exams are stored as an Excel file, the saved report as Compiled HTML format.

Creating a MPEGvue exam

1. Export the actual patient record as described on page 29. Make sure to select **MPEGvue** as export destination.

Reading a MPEG exam

A MPEG exam can be read from any computer with Windows 98/2000/XP, provided that DirectX 8.1 or later and Windows Media Player 7.1 or later are installed.

Refer to the MPEGvue User Manual for details on readings MPEG exams on a computer.

To delete an image from the clipboard

Images can be deleted from the clipboard when in the *Image analysis screen* as described below or from the *Review screen* as described on page 71.

1. Select an image from the clipboard.
2. Press the **Right mouse button**.
3. Select **Delete clipboard cell** from the *Update menu*.
   A pop-up dialog box is displayed asking for confirmation of the deletion.
4. Press **OK** to delete the image.

DICOM spooler

DICOM spooler displays the current DICOM output jobs. The jobs may be Storage, Print, Modality Performed Procedure Step or Storage Commitment. The DICOM spooler is used for checking the current job's status when a job is saved or when the total spooler status on the right of the *Archive windows* displays an error.

From the DICOM spooler the user can also:

- **Delete** non-active jobs
- **Resend** a job that has failed or is in hold
- **Send** a job that has failed or is in hold, to a new destination.
- **Hold** a job that is not active.

The job's status displayed in the *DICOM spooler window* can be:

- **Pending**: the job is complete, waiting to be active.
- **Hold**: the job is complete, but suspended, waiting for an user action.
- **Append**: the job is incomplete, waiting for more images (Direct store function).
- **Active**: the job is complete and connected to the destination device.
- **Failed**: the job is complete but one or more images failed to transmit to the destination device.
- **Done**: the job is saved to the destination device. The jobs that are done are removed from the spooler after a while.

Starting the DICOM spooler

Alternative: Press **F4**.

1. On the alphanumeric keyboard, press and hold down the **ALT** key and press **S**.
   The *DICOM spooler window* is displayed (see Figure 3-20).

The *DICOM spooler window* is automatically updated. Press **Refresh** to update the information displayed at any time.

Figure 3-20: The DICOM job spooler window

Deleting a job

Only non-active jobs can be deleted.

1. Select the job to delete in the *DICOM job spooler window*.
   Note: several jobs can be selected.
2. Press **Delete**.

Resending a job

Only jobs that failed or are in hold can be resent.

1. Select the job to resend in the *DICOM job spooler window*.
   Note: several jobs can be selected.
2. Press **Resend**.
3. Press **SELECT**.

Sending a job to a new destination

Only jobs that failed or are in hold can be sent to a new destination.

1. Select the job to send in the *DICOM job spooler window*.
2. Press **Send to...**.
   A dialogue window is displayed.
3. Select the new destination from the *Destination popup menu*.
4. Press **Send**.

Holding a job

1. Select the job to hold in the *DICOM job spooler window*.
   Note: several jobs can be selected. Only inactive jobs can be set on hold.
2. Select **Hold**.
   To undo hold, press **Resend**.

Chapter 4
Measurements and Analysis

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Introduction

EchoPAC PC provides functionality for two measurement conventions:

A study is a set of related measurements, or measurements that are logically grouped together. The measurements in a study are sometimes used in a formula to calculate new parameters (e.g. biplane volume with EF, SV and CO).

- **Assign and Measure (Measure Protocols)**: the user selects a study consisting in a set of pre-labeled measurements related to the active scanning mode and clinical application. The user is prompted through the measurements in the order of the measurements labels. This convention is started from the **Measure** button. A set of tools is implemented to make the measurement process as fast and easy as possible for the user:
  - The user is guided through the study: an auto-sequence functionality automatically selects the next measurement in a study.
  - The selected measurement is highlighted in the *Measurement menu*.
  - The performed measurement is indicated in the *Measurement menu*.

The studies and their parameters are user-configurable. The user can create its own studies containing the relevant measurements only.

- **Measure and Assign (Free style)**: the user performs a measurement and assigns a label. This convention is started either from the buttons **Measure** or **Caliper**.

△
CAUTION

Only assigned measurements are saved when ending the examination.

About Measurement results display

Be aware of the following:

- Measurement results display

  By default the system always displays absolute values for parameters measured in Doppler. This means that values from above and below baseline will all be displayed as positive results.
  For Cardiac this behavior cannot be changed. For non-Cardiac the Absolute Value setting can be turned off in

Config -> **Meas/Text** -> **Advanced**, by setting the attribute **Absolute Value** to Off.

- Calculated parameters

  For calculated parameters the system uses signed values in calculation formulas, and displays the absolute value of the result.

Assign and Measure modality

In this measurement modality, the user selects a study consisting in a set of related pre-labelled measurements.

Starting the Assign and Measure modality

1. In the *Image analysis screen*, click on **Measure**.
   The *Measurement Menu* is displayed over the control panel (see example Figure 4-1).
   The cursor is in the display window, ready for starting measurement.

1. **Active application**
2. **Study**
3. **Selected study**
4. **Opened study**
5. **Measurements related to the area study for the cardiac application**

The studies are configurable (see page 293).

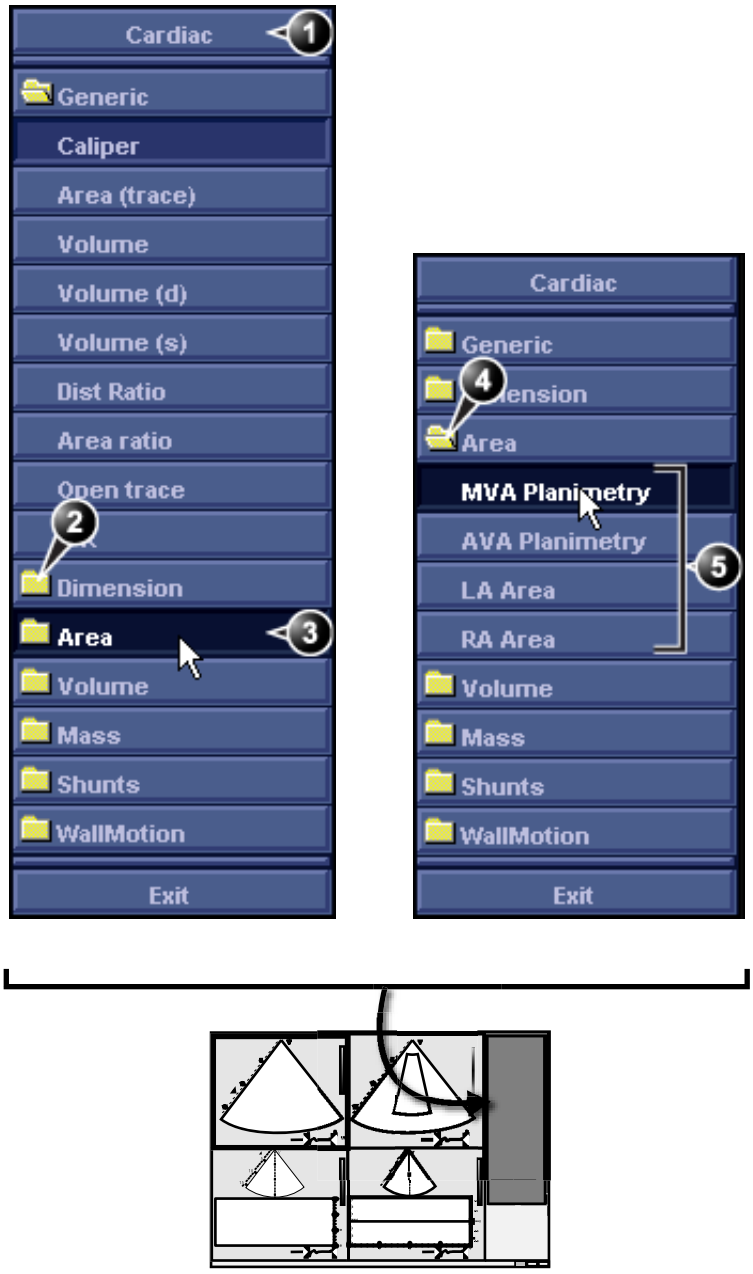


Figure 4-1: Example of a measurement study

Entering a study and performing measurements

1. Press **Measure** on the front panel to enter the Assign and Measure modality.
   The *Measurement menu* with a list of studies is displayed in the *Parameters window* (see example Figure 4-1).
   When entering the Measurement mode for the first time, the Caliper tool is selected by default. When re-entering the Measurement mode, the first measurement in the actual study that has not been performed is selected by default.

To perform a measurement from another study:

1. Select to the required study.
   The study folder is opened, displaying the measurements related to this study. Other related studies may also be available from within this study.
2. Select the measurement to perform.
3. Perform the measurement.
   Completed measurements are marked with a check mark Figure 4-2). When the measurement operation is completed the next measurement on the list is automatically selected.

To skip a measurement in a study

1. Select the desired measurement.

1. **Performed measurement**
2. **Next measurement is automatically selected**

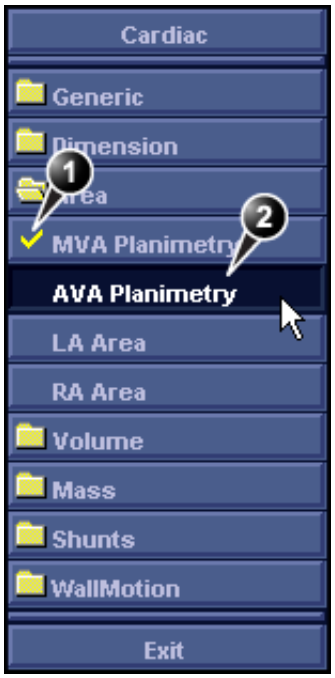


Figure 4-2: Display of a performed measurement (example)

Measure and Assign modality

In this measurement modality, the user performs a measurement and assign a label.

△
CAUTION

Only assigned measurements will be saved.

Starting the Measure and Assign modality

Alternative: Select ***Caliper*** *on the control panel and select the measurement tool from the assignables.*

1. In the *Image analysis screen*, click on **Measure**. The *Measurement Menu* is displayed over the control panel.
2. If not already selected, select the actual measurement tool (see Figure 4-3).

1. Measurement tools

Figure 4-3: the 2D Mode Measurement tools (Cardiac application)

Post-measurement assignment labels

Each type of measurement, within each mode, can be associated with a set of pre-defined parameter labels. Parameter labels can be assigned to the highlighted measurement by the user.

To assign a parameter label to a measurement:

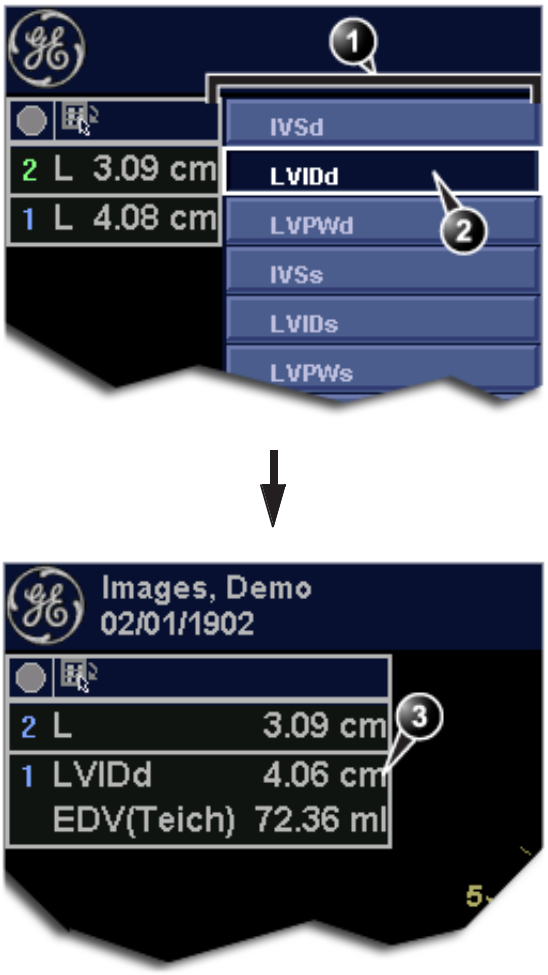
*The selection of a measurement without pre-defined labels will not display the **Parameter label menu**.*

1. Select to the actual measurement in the *Measurement result table* (see Figure 4-4).
   A *Parameter label menu* is displayed.
2. Select the required label in the *Parameter label menu*.

The assigned measurements may be reviewed in the Worksheet (see Chapter 7, ’Worksheet’ on page 235). Up to five assigned measurements with the same label can be stored in the patient archive.

△
CAUTION

Only assigned measurements will be saved. Measurements without assignment will be lost when scanning is resumed.



1. **Parameter Label menu**
2. **Selected label**

Assignment

3. **Assigned measurement**

Figure 4-4: Measurement assignment

To assign a user-defined parameter label

1. Select to the actual measurement in the *Measurement result table* (see Figure 4-4).
   A *Parameter label menu* is displayed.
2. Select **User**.
   The *Enter new parameter window* is displayed.

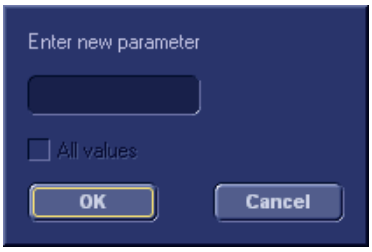


Figure 4-5: The Enter new parameter window

3. Type a name for the parameter label.
4. Press **OK**.
   The user defined parameter label is assigned to the selected measurement.

Cardiac Measurements

2D Measurements

2D Length measurements

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

*Alternative: Press **Caliper** and select **Caliper** from the pull-down menu.*

2. Press **Measure**.
3. Select **Caliper** in the *Measurement Menu* (see Figure 4-3).
4. Move the cursor to the start point of the measurement.
5. Press the **Left mouse button** to anchor the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

6. Move the cursor to the measurement end point.
   The current distance value is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.
7. Press the **Left mouse button** to anchor the end point of the measurement.
   The measurement result is displayed in the *Measurement result table*.

The measurements displayed on the 2D image and the corresponding results are numbered.

8. To assign a label to the measurement, see page 111.
9. Repeat steps 5 through 8 to make additional length measurements.

2D length measurement ratio

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

*Alternative: Press **Caliper** and select **Dist Ratio** from the pull-down menu.*

2. Press **Measure**.
3. Select **Dist. ratio** in the *Measurement Menu* (see Figure 4-3).
4. Perform two length measurements as described in the above section.
   The measurement results including the ratio (%) of the two measured lengths are displayed in the *Measurement result table*.

*See the **Status bar** to get the next step to perform.*

Editing 2D Length measurements

1. Double click on the anchor point to move.
2. Drag the anchor point to a new position.
3. Press the **Left mouse button** to anchor the point at the new location.

2D Area measurements

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

*Alternative: Press **Caliper** and select **Area** from the pull-down menu.*

2. Press **Measure**.
3. Select **Area** in the *Measurement Menu* (see Figure 4-3).
4. Move the cursor to the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

5. Press the **Left mouse button** to anchor the start point of the measurement.
6. Trace the area (planetary) by dragging the mouse.
   The current area and circumference values are displayed in the *Measurement result table* and are instantaneously updated when moving the cursor.
7. Press the **Left mouse button** to complete the measurement.
   The measurement result is displayed in the *Measurement result table*.

The measurements displayed on the 2D image and the corresponding results are numbered.

8. To assign a label to the measurement, see page 111.
9. Repeat steps 4 through 7 to make additional area measurements.

2D area measurement ratio

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

*Alternative: Press **Caliper** and select **Area Ratio** from the pull-down menu.*

2. Press **Measure**.
3. Select **Area ratio** in the *Measurement Menu* (see Figure 4-3).
4. Perform two area measurements as described in the above section.
   The measurement results including the ratio (%) of the two measured areas are displayed in the *Measurement result table*.

Editing 2D Area measurements

1. Double click on the anchor point to move.
   The selected marker turns green and is unanchored.
2. Drag the anchor point to a new position.
3. Press the **Left mouse button** to anchor the point at the new location.

2D Volume measurements

The measurements described in this section enable volume measurement in a defined zone. The measurements tool generates results by two methods:

- Method of Disk (displayed as **Vmod** in the *Measurement result table*), known as Simpson's method.
- Area/Length method (displayed as **Va-l** in the *Measurement result table*).

To perform a volume measurement:

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.

*Alternative: Press **Caliper** and select **Volume** from the pull-down menu.*

2. Press **Measure**.
3. Select **Volume** in the *Measurement Menu* (see Figure 4-3).
4. Move the cursor to the start point of the measurement.
5. Press the **Left mouse button** to anchor the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

6. Draw the length by dragging the mouse.
7. Press the **Left mouse button** to anchor the second point.
8. Drag the mouse to outline the area of interest.
   The current area, circumference and Area/Length Volume (Va-l) values are displayed in the *Measurement result table* and are instantaneously updated when moving the cursor.
9. Press the **Left mouse button** to complete the measurement.
   The measurement results including Vmod (Simpson) are displayed in the *Measurement result table*.

The measurements displayed on the 2D image and the corresponding results are numbered.

10. To assign a label to the measurement, see page 111.
11. Repeat steps 4 through 9 to make additional volume measurements.

2D Depth measurements

The measurements described in this section enable depth measurement from the probe to a selected point.

To perform a depth measurement:

1. If necessary, deselect **Run cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to select the desired frame.
2. Press **Measure**.

*Alternative: Press **Caliper** and select **Point** from the pull-down menu.*

3. Select **Point** in the *Measurement Menu* (see Figure 4-3).
4. Move the cursor to the position to measure.
   The current distance from the probe is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.
5. Press the **Left mouse button** to anchor the point.
   The depth value (cm) is displayed in the *Measurement result table*.

M-Mode Measurements

In M-Mode, the user can perform distance and time measurements. This measurement package has also the following pre-defined measurement studies:

- LA/Ao
- LV
- RV

M-Mode Length measurements

1. Press **Measure**.
2. Select **caliper** in the *Measurement Menu*.

*Alternative: Press **Caliper** and select **Caliper** from the pull-down menu.*

3. Move the cursor to the start point of the measurement.
4. Press the **Left mouse button** to anchor the point.
5. Move the cursor to the measurement end point.
   The current distance value is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.
6. Press the **Left mouse button** to anchor the end point of the measurement.

The measurements displayed on the M-Mode image and the corresponding results are numbered.

The measurement result is displayed in the *Measurement result table*.

7. To assign a label to the measurement, see page 111.
8. Repeat steps 3 through 6 to make additional length measurements.

Editing M-Mode Length measurements

1. Double click on the anchor point to move.
   The selected marker turns green and is unanchored.
2. Drag the anchor point to a new position.
3. Press the **Left mouse button** to anchor the point at the new location.

Ao/LA study

*Alternative: Press **Caliper** and select **Ao/LA** from the pull-down menu.*

1. Press **Measure**.
2. Select **Ao/LA** in the *Measurement Menu*.
3. Move the cursor along the time axis to the required point to start measurement of Aorta root diameter.
4. Press the **Left mouse button** to anchor the starting point for the measurement.

*See the **Status bar** to get the next step to perform.*

5. Move to the measurement end point.
6. Press the **Left mouse button** to anchor the measurement end point.
   The Aorta root diameter measurement value is displayed in the *Measurement result table*.
   A new free-moving cursor is displayed on the image, ready for the next measurement.
7. Repeat steps 3, through 6 to measure Left Atrium.
   The LA value is displayed in the *Measurement result table*.
   The Ao/LA ratio is displayed in the *Measurement result table*.

LV study

The LV study consists of measurements in fixed-time mode in both systole and diastole of:

- Interventricular septum thickness (IVS)
- Left ventricular internal dimension (LVID)
- Left ventricular posterior wall thickness (LVPW)

The following parameters are also calculated:

- EDV (End diastole volume)
- ESV (End systole volume)
- SV (Stroke volume)
- EF (Ejection Fraction)

To perform LV study

*Alternative: Press **Caliper** and select **LV study** from the pull-down menu.*

1. Press **Measure**.
2. Select **LV study** in the *Measurement Menu*.
3. Move the cursor along the time axis to the required point to start measurement of IVSd.
4. Press the **Left mouse button** to anchor the point.

*See the **Status bar** to get the next step to perform.*

5. Move to the end point of the measurement.
6. Press the **Left mouse button** to anchor the measurement end point.
   The IVSd measurement value is displayed in the *Measurement result table*.
   The end point of the IVSd is also the start point for the LVIDd.
7. Move to the end point of the LVIDd measurement.
8. Press the **Left mouse button** to anchor the point.
   The LVIDd measurement value is displayed in the *Measurement result table*.
   The end point of the LVIDd is also the start point for the LVPWd.
9. Move to the end point of the LVPWd measurement.
10. Press the **Left mouse button** to anchor the point.
    The LVPWd measurement value is displayed in the *Measurement result table*.
11. Repeat steps 3, through 10 to measure IVS, LVID and LVPW in systole.

RV study

The RV study consists of measurement in fixed-time mode of Right ventricular internal dimension (RVID) in both diastole and systole.

To perform RV study

*Alternative: Press **Caliper** and select **RV study** from the pull-down menu.*

1. Press **Measure**.
2. Select **LV study** in the *Measurement Menu*.

3. Move the cursor along the time axis to the required point to start measurement of RVIDd.
4. Press the **Left mouse button** to anchor the measurement starting point.
5. Move to the end point of the measurement.
6. Press the **Left mouse button** to anchor the measurement end point.
   The RVIDs measurement value is displayed in the *Measurement result table*.
   A new free-moving cursor is displayed on the image, ready for the next measurement.
7. Repeat steps 3, through 6 to measure RVIDs.
   The RVIDs value is displayed in the *Measurement result table*.

Doppler Measurements

The following measurements may be calculated on Doppler mode spectra:

- Maximum (peak) and mean velocity
- Maximum and mean pressure gradient
- Pressure half-time (PHT)
- Velocity time integral (VTI)
- Mitral valve area (MVA), derived from PHT

Velocity and Pressure point measurements

*Alternative: Press **Caliper** and select **Point Caliper** from the pull-down menu.*

1. Press **Measure**.
2. Select **Point Caliper** in the *Measurement Menu*.
3. Move the cursor to the position to measure.
   The current velocity is displayed in the *Measurement result table* and is instantaneously updated when moving the cursor.
4. Press the **Left mouse button** to anchor the point.
   The velocity (m/s) and pressure (mmHg) values are displayed in the *Measurement result table*.

Velocity and Pressure caliper measurements

*Alternative: Press **Caliper** and select **Caliper** from the pull-down menu.*

1. Press **Measure**.
2. Select **Point Caliper** in the *Measurement Menu*.
3. Move the cursor to the start point of the measurement.

4. Press the **Left mouse button** to anchor the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

5. Move the cursor to the measurement end point.
   The current velocity and pressure values are displayed in the *Measurement result table* and are instantaneously updated when moving the cursor.
6. Press the **Left mouse button** to anchor the end point of the measurement.
   The following measurement results are displayed in the *Measurement result table*:
   - Velocity and pressure at anchor point positions
   - Velocity (V3) and pressure (p3) differences between anchor point position
   - Time difference (dT) between anchored points position

The measurement display on the spectrum and the corresponding result are numbered.

7. To assign a label to the measurement, see page 111.
8. Repeat steps 3 through 6 to make additional measurements.

Manual Doppler trace measurements

*Alternative: Press **Caliper** and select **Manual trace** from the pull-down menu.*

1. Press **Measure**.
2. Select **Manual trace** in the *Measurement Menu*.
   A vertical green cursor is displayed on the spectrum.
3. Move the cursor to the start point on the left side of the trace.
4. Press the **Left mouse button** to anchor the start point of the measurement.
5. Trace the Doppler envelope.
   The trace can be adjusted, while tracing, by moving the cursor backward to erase portion of the trace (or the entire trace) and then create the trace again.
6. Press the **Left mouse button** to complete the trace.
   The following measurement results are displayed in the *Measurement result table*:
   - Maximum and mean Velocities
   - Maximum and mean pressures
   - Env. Ti
   - Velocity time integral (VTI)
7. Move the cursor to the start point of the next heart beat.

8. Press the **Left mouse button** to anchor the next heart beat starting point.
   The heart rate (BPM) is displayed in the *Measurement result table*.

Automatic Doppler trace measurements

*Alternative: Press **Caliper** and select **Auto trace** from the pull-down menu.*

1. Press **Measure**.
2. Select **Auto trace** in the *Measurement Menu*.
   A vertical green cursor is displayed on the spectrum.
3. Move the cursor to the starting point.
4. Press the **Left mouse button** to anchor the start point of the measurement.

*See the **Status bar** to get the next step to perform.*

5. Move to the end trace position.
6. Press the **Left mouse button** to anchor the end point of the trace.
   The trace is automatically generated and the following measurements are displayed in the *Measurement result table*:
   - Maximum and mean Velocities
   - Maximum and mean pressures
   - Env. Ti
   - Velocity time integral (VTI)
7. Move the cursor to the next heart beat.
8. Press the **Left mouse button** to anchor the next heart beat starting point.
   The heart rate (BPM) is displayed in the *Measurement result table*.

MV E/A ratio

*Alternative: Press **Caliper** and select **MV E/A ratio** from the pull-down menu.*

1. Press **Measure**.
2. Select **MV E/A ratio** in the *Measurement Menu*.
3. Move the cursor to the peak of the E wave.
4. Press the **Left mouse button** to anchor the point.
5. Drag cursor to baseline to mark dT.

*See the **Status bar** to get the next step to perform.*

6. Press the **Left mouse button** to anchor the second point.
7. Move the cursor to the peak of A wave.
8. Press the **Left mouse button** to anchor the point.
   the velocity at peak for E and A waves and the calculated E/A ratio are displayed in the *Measurement result table*.

Event timing measurements

Event timing enables the time measurement for opening and closure of the Aortic and Mitral valves, as referred to the automatically detected QRS marker, which normally is on the rising slope of the R-wave.

Event timing can be performed on a Doppler spectrum or an M-Mode acquisition showing the corresponding valves. The procedure is similar on both modes. In addition event timing can be done on curved anatomical M-Mode traces in Q Analysis. The measurements are shown as dashed lines in the *Analysis window* and *Anatomical M-Mode window* in Q Analysis.

1. Press **Measure**.
2. Select **Event Timing** in the *Measurement menu*.
   The following event timing measurements are available (with the first measurement on the list selected):
   - **AVO**: Aortic Valve Opening
   - **AVC**: Aortic Valve Closure
   - **MVO**: Mitral Valve Opening
   - **MVC**: Mitral Valve Closure
3. Place the cursor to the corresponding point on the spectrum for the selected measurement.
4. Press the **Left mouse button** to anchor the point.
   The event timing measurement (ms) is displayed in the *Measurement result table*.

TSI Measurements

Each sample in the TSI image represents the time to the maximum velocity within the chosen TSI search interval from TSI Start to TSI End.

The TSI search interval may be adjusted as follow:

1. Press **Config** (F2) and select the category **Measure/Text**.
2. In the *Measure category*, select the sheet **Advanced**.
3. In the *Application specific parameters section* adjust TSI start and TSI end parameters by selecting a new value from the combo menu displayed upon selection.

There are two automatic TSI time to peak measurement tools:

- **Generic TSI Time to peak measurement**: displays the TSI value at the location point set by the user.
- **Segment TSI Time to peak measurement**: measures the time to peak velocity in specific wall segments and gets automatically calculated TSI indexes based on these measurements. The measurements may be presented in a color coded Bull's eye diagram.

Alternatively, TSI time to peak measurement can be done in Q Analysis by manually measuring the time between the QRS marker and the peak velocity on the velocity trace.

Generic Time to peak measurement

1. Open a TSI apical loop
2. Press **Measure**.
3. In the *Measurement menu*, select **Generic** and **Time to peak** (see Figure 4-6).
   The TSI loop freezes at the TSI end frame.
4. Place a point in the middle of a basal or mid-level myocardial segment in the TSI image.
5. The Time to peak value for the segment is displayed in the *Measurement result window*.
   Note: to judge the quality of your data at the measuring point in the 2D image see the Caution text on page 130.

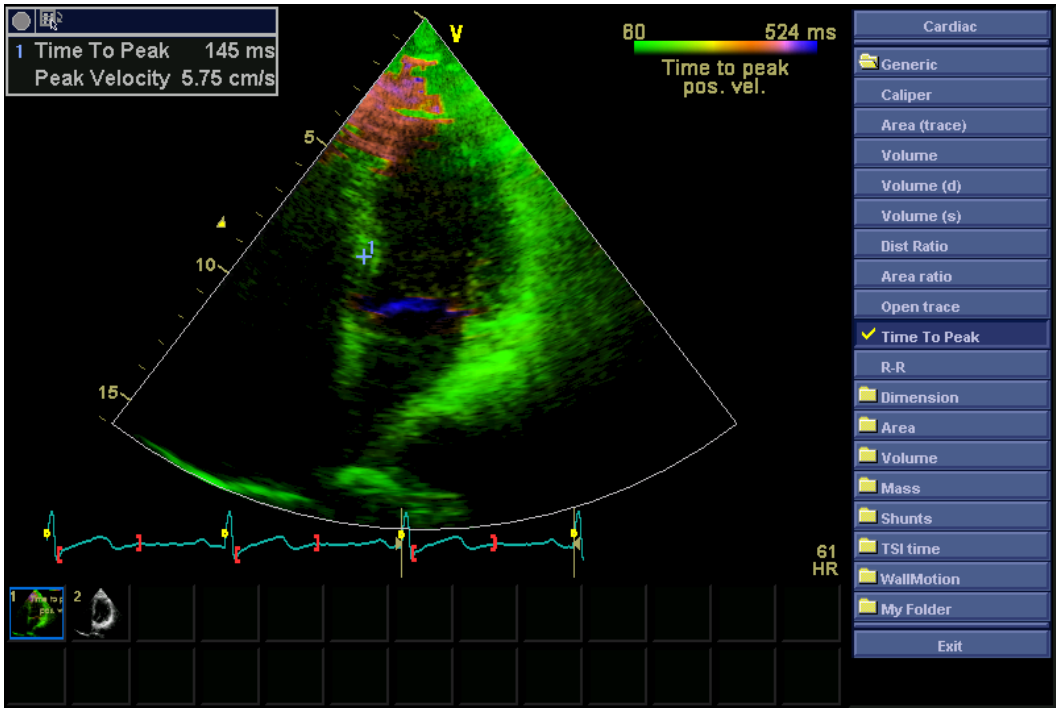


Figure 4-6: TSI Generic Time to peak measurement screen

Segment Time to peak measurements

1. Open TSI loops from all three apical views.
2. Select **Measure** and **TSI time** study in the *Measurements menu*.
   The TSI loop freezes at the TSI end frame.
   The first measurement in the study is automatically selected (see Figure 4-7).
3. Place a point in the middle of the corresponding segment in the TSI image.
   The Time to peak and the Peak velocity for the segment are displayed in the *Measurement result window*.
4. Perform a measurement for all basal and mid-level segments in all three apical views.
   In addition to the Time to peak and the Peak velocity for each segment, the following TSI indexes are calculated:
   - *Septal lateral delay*: difference in Time to peak velocity in the basal lateral wall and basal septum.
   - *Septal posterior delay*: difference in Time to peak

velocity in the basal posterior wall and the basal antero-septum.

- *Basal max delay*: difference between the maximum and minimum time to peak measurements in the six basal segments. Requires at least four of the six basal segment measurements.
- *Basal standard deviation*: the standard deviation of the time to peak measurements in the six basal segments. Requires at least four of the six basal segment measurements.
- *All segments max delay*: difference between the maximum and minimum time to peak measurements in all the measured basal and mid level segments. Requires at least eight of the twelve segmental measurements.
- *All segments standard deviation*: the standard deviation of the time to peak measurements in all measured basal and mid level segments. Requires at least eight of the twelve segmental measurements.

The TSI indexes indicate degrees of asynchrony in time to peak velocity

5. Select **TSI Bull's eye report** in the *Measurement menu*. The measurements are displayed in a color coded bull's eye diagram together with a list of the calculated TSI indexes.

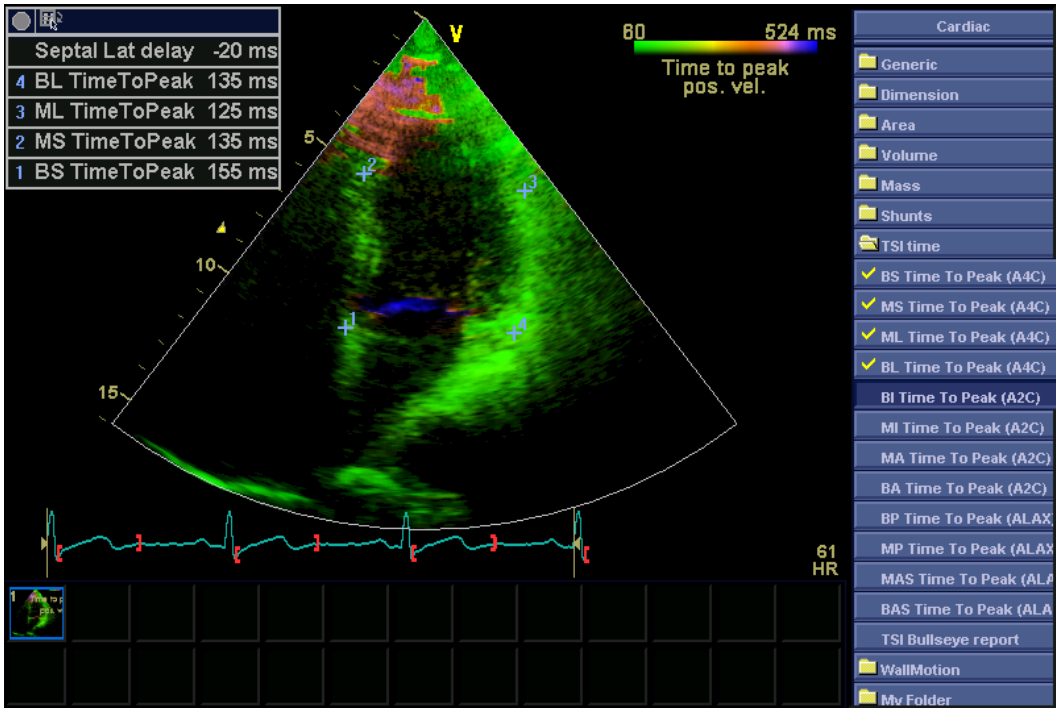
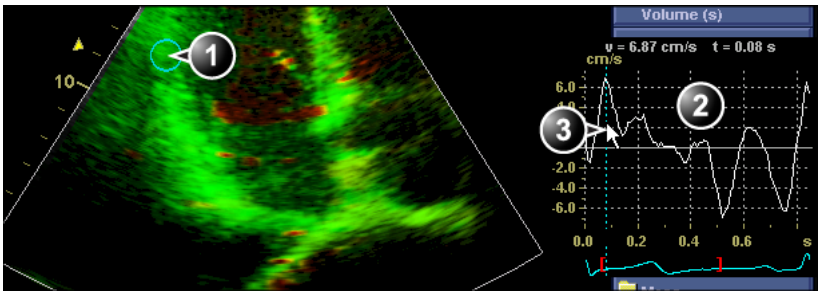


Figure 4-7: Segment Time to peak measurements screen

TSI trace

The TSI Time to peak measurement can be verified and eventually manually changed from the TSI trace.

1. Double click on the measurement point.
   The ROI and the corresponding TSI curve are displayed (see Figure 4-8).
2. Press the Left mouse button to anchor the ROI and trace.
3. If required, select a new peak location in the trace.
4. Click in the acquisition window to exit the TSI trace.

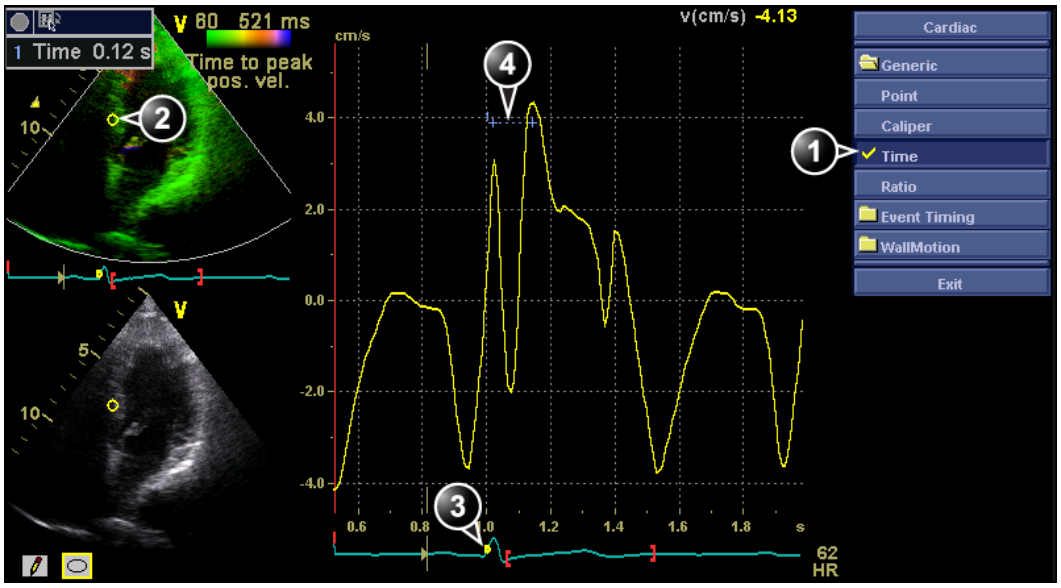


1. **TSI ROI**
2. **TSI trace**
3. **TSI Time to peak marker**

Figure 4-8: TSI trace

Time to peak measurement in Q Analysis

1. From a TSI apical loop, press **Q Analysis**.
2. Place a sample area in a myocardial segment.
   A velocity trace is displayed in the *Analysis window* (see Figure 4-9).
3. Press **Measure**.
4. In the *Measurement menu*, select **Generic** and **Time**.
   Note: if **Time** is not available in the *Generic folder*, minimize the *Measurement menu* and press **Active Mode**. Minimize the main Control panel to display the *Measurement menu* again.
5. In the *Analysis window*, measure the time from the yellow QRS marker to the peak velocity of the velocity trace.



1. **Time measurement tool**
2. **Sample area**
3. **QRS marker**
4. **Time to peak measurement**

Figure 4-9: Manual TSI Time to peak measurement in Q Analysis

Note: it is possible to do a Generic or a Segment Time to peak measurement from within Q Analysis and compare the result with a manual Time to peak measurement. To access to the corresponding measurement tool in Q Analysis you may have to press **Active Mode** to display the relevant Measurement menu.

CAUTION

The Time to peak measurement in Q Analysis may differ from the Generic and Segment Time to peak measurements due to the following considerations:

- ***The Generic and Segment Time to peak measurements find the maximum velocity only within the TSI search interval. If the desired peak on the velocity trace is outside the TSI search interval, the Generic and Segment Time to peak measurements will return a different result than the manual Time to peak measurement.***
- ***If the maximum velocity is at one of the ends of the TSI search interval, the Generic and Segment time to peak measurements return the time of the end of the TSI search interval. In some cases the falling flank of an iso-volumic contraction peak at the time of TSI Start or the rising flank of a post-systolic contraction peak at the time of TSI End may be detected. In a manual measurement the time to a peak within the TSI search interval with a lower velocity than the velocity at the end of the interval may be measured instead.***
- ***If there are two or more peaks of comparable velocity within the TSI search interval, or a poor signal quality, the Generic and Segment Time to peak measurements may return the time to a different peak than what a manual method would do. Typically in these situations, the TSI image will show a wide range of colors over a small spatial region.***

Automated Function Imaging

Automated Function Imaging (AFI) is a decision support tool for regional assessment of the LV systolic function. AFI is a tool derived from 2D Stain, which calculates the myocardial tissue deformation based on feature tracking on 2D grey scale loops.

AFI is performed on apical views in the following order: apical long-axis, 4-chamber and 2-chamber view, following an on screen guided workflow (see also Figure 4-10).

The result is presented as a Bull’s eye display showing color coded and numerical values for peak systolic longitudinal strain. All values are stored to the worksheet. In addition, global strain for each view and average global strain for the whole LV are stored to the worksheet.

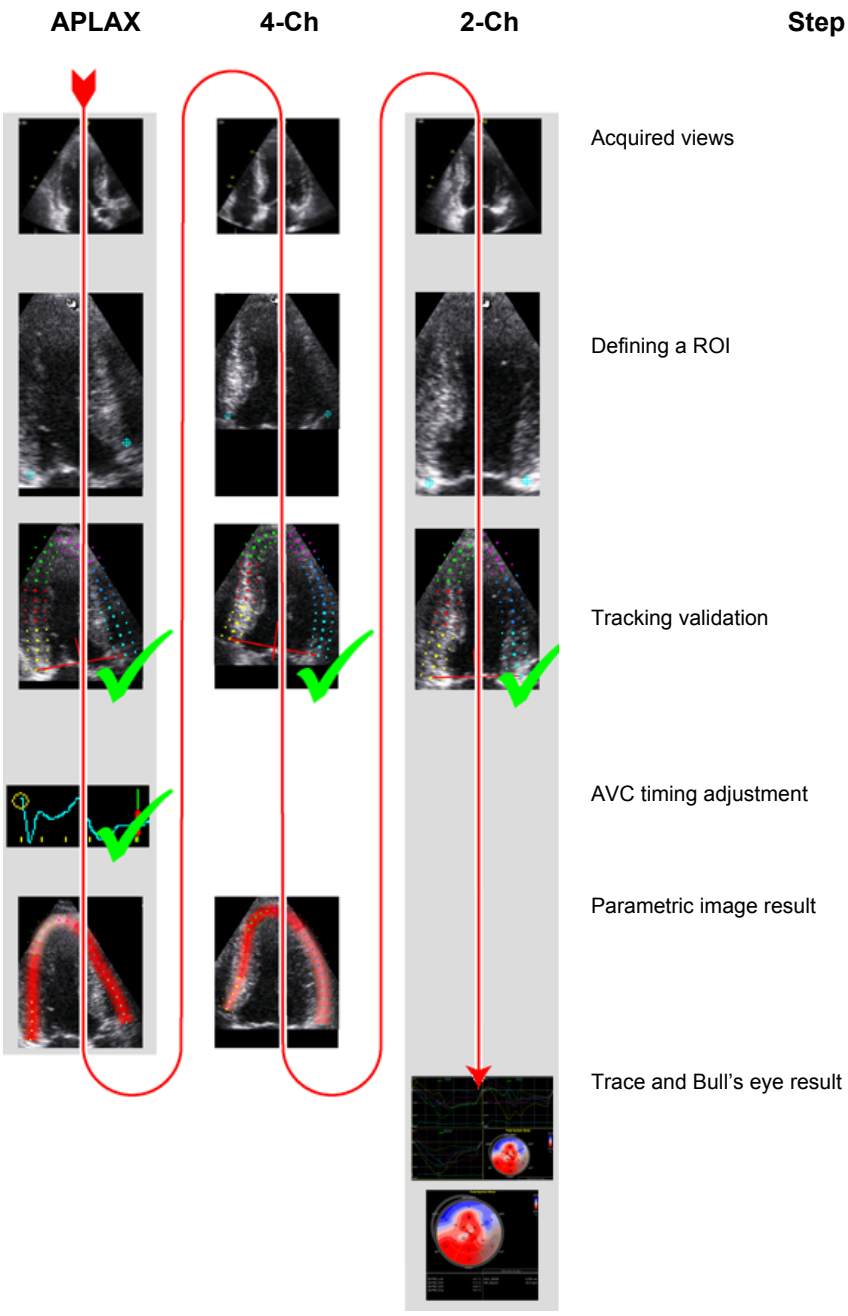


Figure 4-10: AFI workflow

Acquisition

Automated function Imaging is performed on 2D grey scale cineloops of an Apical long axis (APLAX) view, an Apical 4 chamber view and an Apical 2 chamber view.

For optimal result the acquisitions should conform to the following recommendations:

- All three apical views should be acquired sequentially in order to get similar heart rate in all views.
- The frame rate should be between 37 and 80 frames per second. A higher frame rate is recommended for high heart rate.
- The scanner should be configured to store 100 ms before and after each heart cycle.
- The entire myocardium should be visible.
- The acquisitions should have a depth range that cover the entire left ventricle.

Starting AFI

1. Open an APLAX view and press **Measure**.
2. In the *Measurement menu*, select **AFI**.
   The *View selection menu* is displayed (see Figure 4-11).

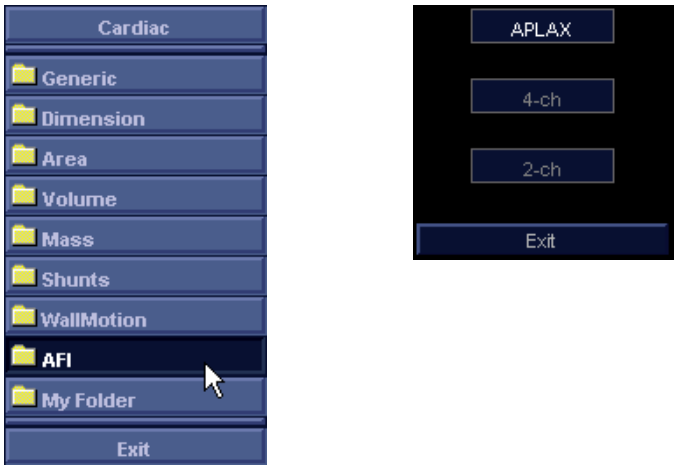


Figure 4-11: Measurement and View selection menus

3. Select **APLAX**.

The AFI application is started. A ROI can be defined.

CAUTION

When performing AFI on all three apical views, the user is asked to start with the APLAX view. This allows manual adjustment of the Aortic Valve Closure (AVC) event timing that is used in the calculation of the longitudinal systolic strain in all apical views.

AFI on the APLAX view

Defining a ROI

When selecting the view to analyze the system automatically displays a frame where the endocardial border is usually clearly visible. To use another frame, adjust **Ref. frame**. The ROI is defined by placing two annular points and one at the apex following the order shown on screen.

To define a ROI, place three points at the endocardial border; two annular points and one at the apex (see Figure 4-12). Follow the indications displayed on the screen when placing the three points.

Note: the Yo-yo function is turned on to help finding correct location for the points.

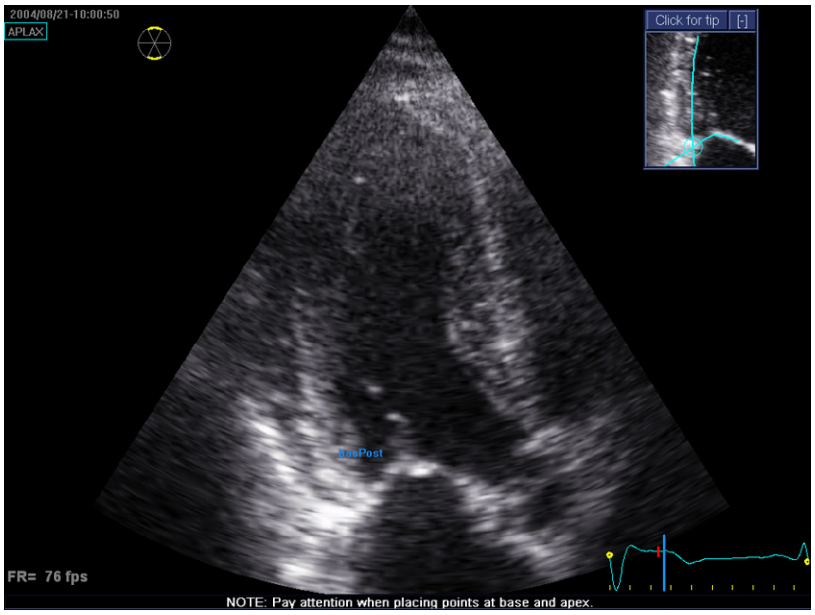


Figure 4-12: Defining a ROI

After placing the apex point the ROI is displayed.

Note: Correct ROI definition is important for an accurate strain measurement. The system has an adaptive ROI function: using the endocardial three points as a guide, the system will analyze the image and automatically adapt the ROI to an optimal position.

You may adjust the shape of the ROI by moving the cursor over the inner ROI border, select an anchor point and move it to a new location (Figure 4-13). The shape of the ROI is updated accordingly.

Figure 4-13: Selected anchor point on the inner ROI border

Note: Data processing is started automatically if the cursor is not moved for a few seconds. If the ROI needs to be adjusted make sure to make the changes immediately after the ROI is displayed.

Note: The auto processing function is configurable (from Config/Meas-Text/Advanced/AFI auto processing).

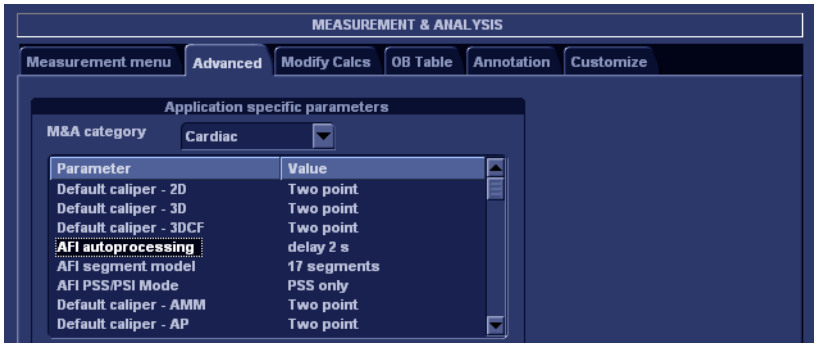
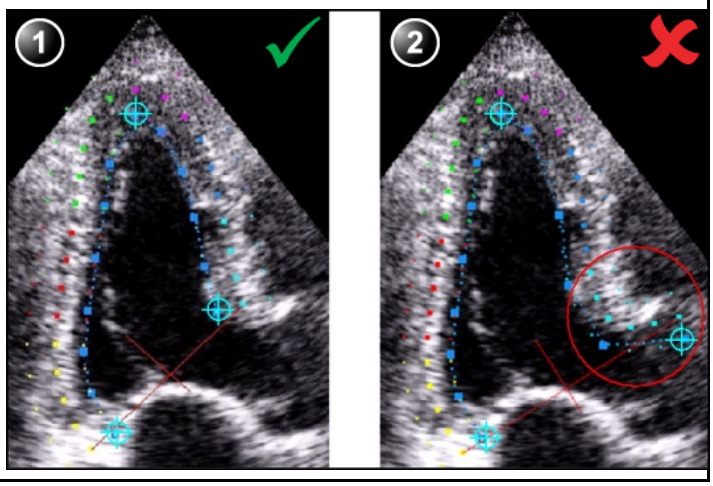
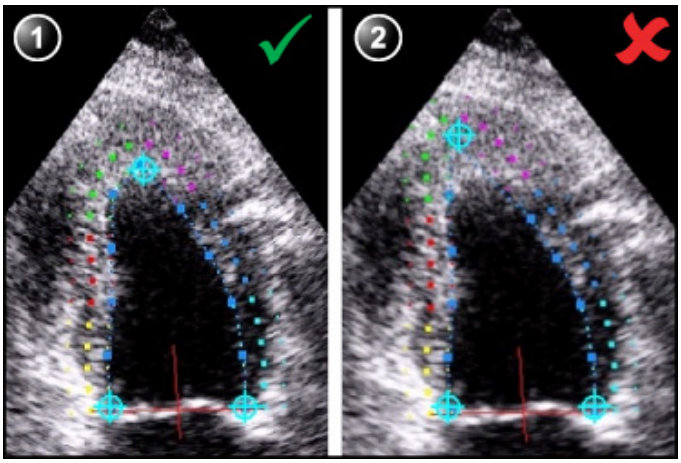


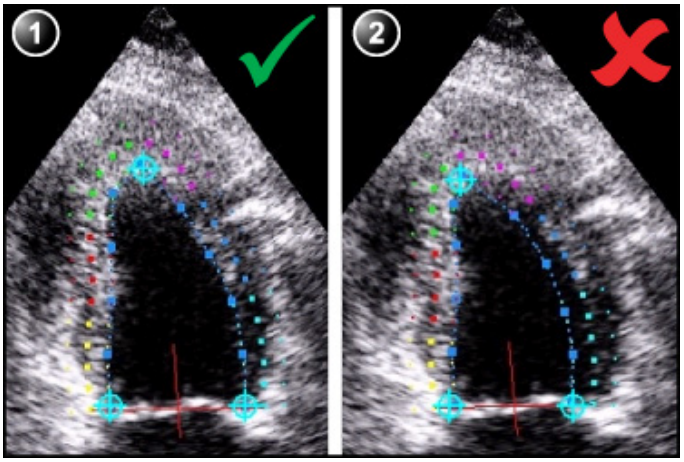
Figure 4-14: AFI auto processing configuration

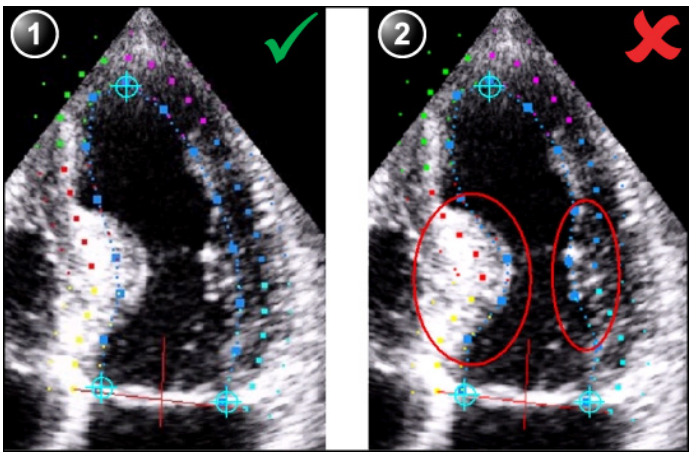
Quick tips

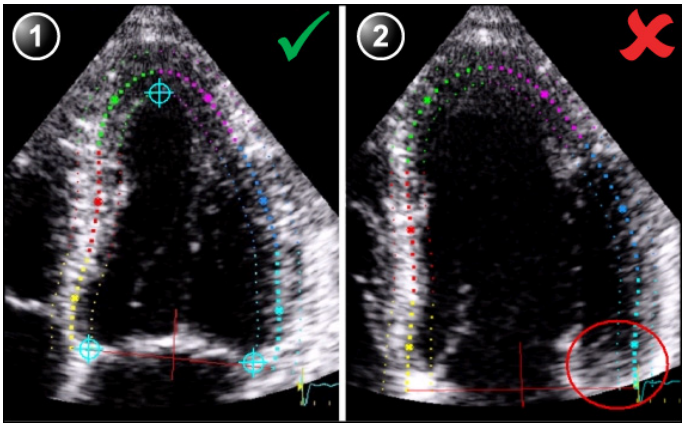
Correct ROI definition is crucial to get good tracking. Refer to the example displayed in the *Tip window* for correct point placements. To display additional guidelines, select the **Tip** button on the *Tip window*. Make sure to follow the recommendations when placing the three points (see below).

Base	Correct	Wrong
1. Correct position of the base points. 2. The ROI extends into the aortic tract.		

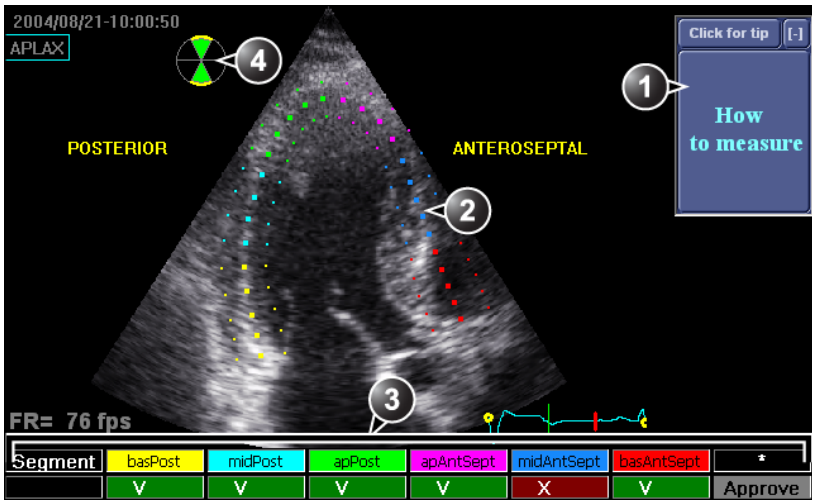
Apex	Correct	Wrong
1. Correct position of the Apex point. 2. The apex point is placed too high. The ROI is extending beyond the epicardium.		

Apex	Correct	Wrong
1. Correct position of the Apex point. 2. The upper right border of the ROI is way too much into the chamber cavity.		

Bulges	Correct	Wrong
1. Correct ROI. 2. ROI should not be bulging or follow the papillary muscle. To edit the ROI, see 'ROI adjustment' on page 139.		

General	Correct	Wrong
The left ventricle must be visible through the entire cycle. 1. End systole frame: the entire left ventricle is displayed. 2. End diastole frame: the annulus is not displayed.		

The data is processed and the *Tracking validation screen* is displayed.



1. **Display Quick Tips on tracking quality assessment**
2. **The ROI divided in segments**
3. **The Scoring table**
   - ✓ **: acceptable tracking**
   - X **: not acceptable tracking**
4. **Bull's eye icon:**
   • Segments with yellow border: segments being analyzed.
   • Green segments: segments already analyzed.
   • Black segments: segments not analyzed.

Figure 4-15: Tracking validation screen

The ROI is divided into segments. The tracking quality for each segment is automatically evaluated and summarized in the *Scoring table* (see Figure 4-15).

Tracking validation

The tracking for each segment must be visually controlled and validated. Poor tracking quality could result from a variety of causes. Select **Quick tips** (see Figure 4-15) to get tips on the most common causes for bad tracking. The common causes for bad tracking are:

- Erroneous placement of the basal points when defining the ROI. If the basal points are placed too far from the annular region, the ROI segments at the annular base will not move together with the underlying 2D image throughout the entire heart beat (see example cineloops in the Quick tips).

- Erroneous placement of the apex point when defining the ROI. The point should be placed so that the resulting ROI covers mainly the endocardium. If the apex point is placed too high, the ROI will mainly cover the epicardium resulting in poor tracking (see example cineloops in the Quick tips).
- Too small ROI width. Narrowing the ROI too much will result in poor tracking due to lack of tissue data in the ROI (see example cineloops in the Quick tips).
- Too much clutter. Images with too much static clutter will result in poor tracking (see example cineloops in the Quick tips).

1. Inspect each segment and make sure that the center line is moving together with the underlying 2D image.
   Note: To get a better visualization you may press **ROI On/Off** to show or hide the ROI borders.
   The tracking quality is automatically evaluated for each segment and displayed in the *Scoring table*.
   If the tracking needs to be improved for some segments, the user can modify the ROI as described in 'ROI adjustment' on page 139.
   The user may override the tracking quality evaluation done by the system by clicking on the evaluation result in the *Scoring table*.
2. Once the tracking quality has been validated for all segments, press **Approve** in the *Scoring table*.
   The user is asked to confirm or adjust the AVC timing setting (see 'Timing validation' on page 140).

ROI adjustment

1. Press **Recalc**.
2. The following adjustments can be done:
   - Adjust **ROI width**.
   - Press **New ROI** to re-define the ROI.
   - Adjust the shape of the existing ROI: move the cursor over the inner ROI border, select an anchor point and move it to a new location. The shape of the ROI is updated accordingly.

   Data processing is started automatically if the cursor is not moved for a few seconds.
   The *Tracking validation screen* is displayed for tracking validation.

Timing validation

Timing information may be crucial to accurate diagnosis. The most important event timing is the aortic valve closure (AVC), since it is part of the definition of the peak systolic strain parameter.

Determination of the AVC timing by the system is as follow, depending on the situation:

- If AVC timing has been measured by the operator (through an event timing measurement, see page 123) prior to running AFI, the system is using this data.
- If event timing is not available, an automatic AVC estimate is used, determined by the temporal contraction of all LV segments (Strain curves).
- From the APLAX view, the user can adjust the estimated AVC timing. The adjusted AVC timing will then be used in the other apical views when running AFI on these views. This option is only available from the APLAX view.

AVC timing adjustment

This procedure is available in the APLAX view only.

1. After validation of the tracking quality, the frame for the current AVC setting (automatic or event timing measurement) is displayed and highlighted on the ECG.
2. To keep the current AVC setting, press the Left mouse button. To change the AVC setting, use the mouse to display another frame and press the Left mouse button. If the AVC setting was changed, a Confirmation window is displayed. Select one of the following options:
   - **Manual** to accept the manual AVC setting.
   - **Event timing** to discard the manual AVC setting (if for example the AVC setting was not possible to assess from the APLAX view). The AVC event timing measurement will then be used.

     Note: This choice is only visible if AVC event timing measurement has been done.
   - **Auto** to discard the manual AVC setting and use the automatic AVC timing.

   The *Parametric systolic strain APLAX view* is displayed (see Figure 4-16).

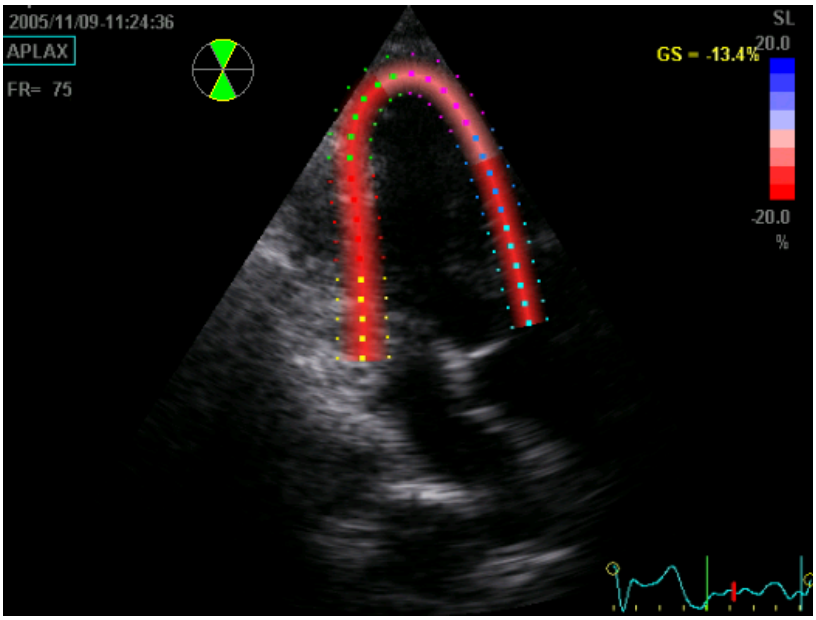


Figure 4-16: Parametric systolic strain APLAX view

Note: the image will not be saved unless the user press **Store**.

Peak detection

The peak systolic strain detection for each segment can be verified and eventually manually changed.

To adjust the peak detection:

1. Press **Quad**.
   A quad screen is displayed (see Figure 4-17) showing:
   - 2D image with the ROI
   - 2D image with Peak systolic strain parametric data
   - Segmental curves with peak marker
   - M-Mode image with strain parametric data

   Note: the *Quad screen* will not be saved unless the user press **Store**.

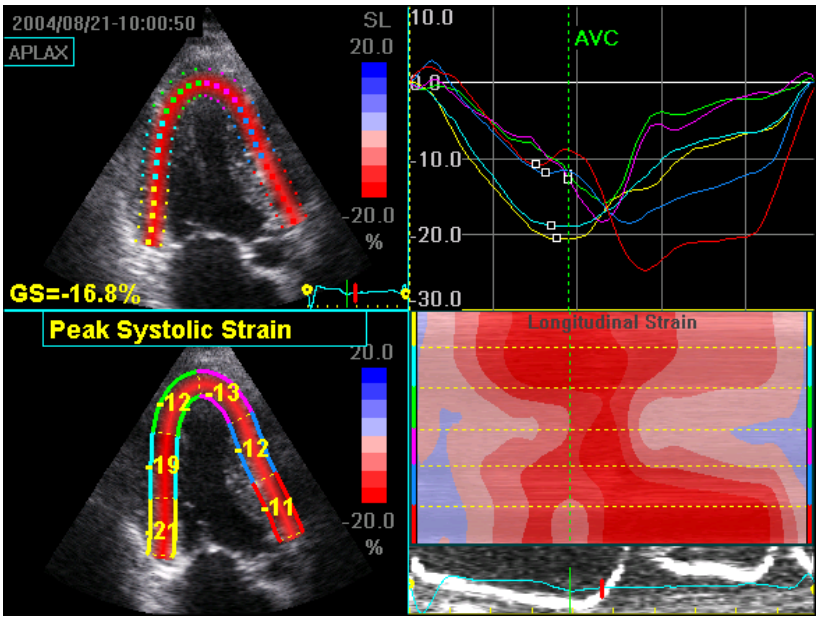


Figure 4-17: Quad screen for the APLAX view

2. To change the peak marker position on a curve:
   - Select the peak marker (white square point) on one of the curves and move it to a new position.

     OR
   - Place the cursor on a segment in one of the 2D images. The corresponding curve is highlighted.

     Click on the segment to select the corresponding peak marker and move it to a new position.

AFI on A4-Ch and A2-Ch views

The procedure for AFI on Apical 4-chamber and 2-chamber views is similar to the one used in the APLAX view:

- Open the apical view from the clipboard.
- Select the corresponding view in the *View selection menu* (see Figure 4-11, page 132).
- Define a ROI (see page 133).
- Validate tracking (see page 138).

Note: the AVC timing setting defined in the APLAX view is used by the system when running AFI on the other apical views.

Results

For the APLAX and apical 4-chamber views the following results are available:

- *Single screen* (see Figure 4-16) displaying a 2D image with strain parametric data.
- *Quad screen* (see Figure 4-17) displaying:
  - 2D image with the ROI
  - 2D image with Peak systolic strain parametric data
  - M-Mode image with strain data
  - Segmental curves

△
CAUTION

If auto-AVC is used as AVC timing calculation method when running AFI (see page 140), the strain values displayed in the Quad screen for the APLAX and 4 Chamber views may differ from the strain values obtained after the system has performed the final calculation from all three views. The reason for this is that the Auto-AVC calculation derived from all three views is most accurate and may be different from the intermediate AVC calculations used for each view. The strain values displayed in the Quad screen on APLAX and 4 Chamber views are therefor preliminary values. Only final strain values should be reported. Note: If you enter Quad screen again after all three loops have been processed, the strain values will be correct.

When performing AFI on all three apical views the following results are also available:

- *Quad curve screen* (Figure 4-18) displaying:
  - Segmental curves for each three Apical views
  - Bull's eye presentation with segmental Peak systolic strain color coding and segmental Peak systolic strain values
- *Single Bull's eye screen* (see Figure 4-19) displaying:
  - Bull's eye presentation with segmental Peak systolic strain color coding and segmental Peak systolic strain values

    Note: The Bull's eye can be configured to display either 18 or 17 segments (from Config/Meas-Text/Advanced/AFI Segment model).

Note: The system can be configured so that the user can also choose to display Post systolic index (PSI) color coding and segmental PSI values in the Bull's eye (from Config/Meas-Text/Advanced/AFI).

- Global Peak strain values for all three apical views.
- Averaged global Peak strain value from all three apical view data.
- AVC measurement (either automatic, event timing measurement or manual, see page 140)

Getting the results

When approving the tracking in the Apical 2-chamber the *Quad curve screen* with segmental curves and Bull's eye is displayed (Figure 4-18). Select **Bull's eye only** to display the *Single Bull's eye screen* (Figure 4-19).

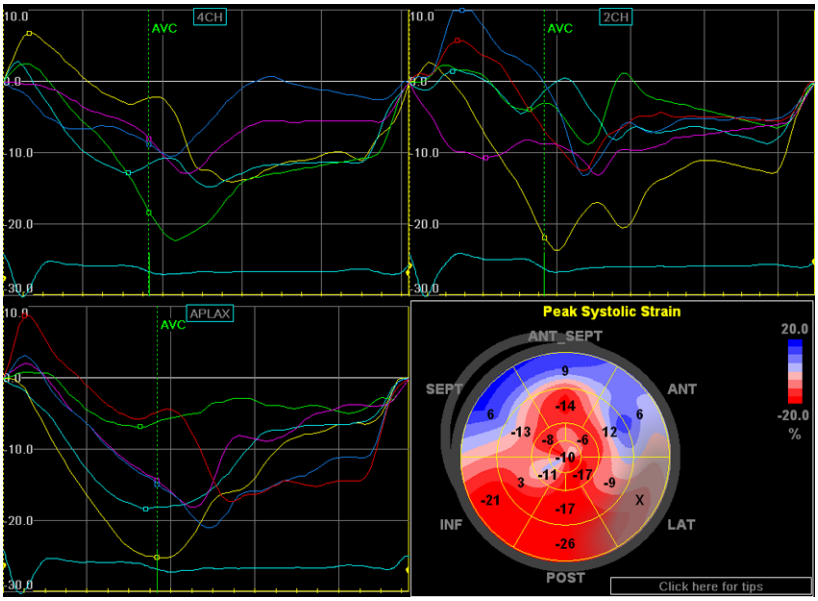


Figure 4-18: Quad screen

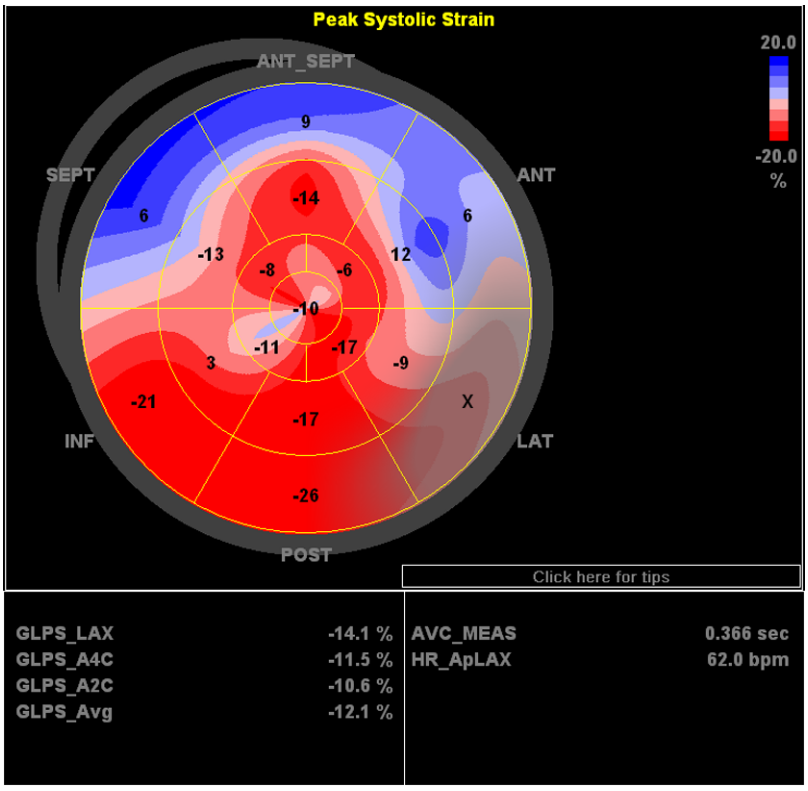
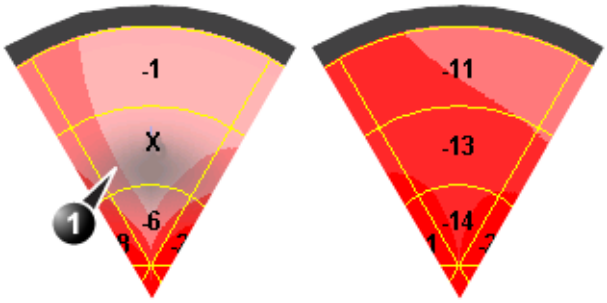


Figure 4-19: Single Bull's eye screen

To save the results, press **Store**. Once the results are saved, the measurements are available in the Worksheet and can be used in the report.

If the tracking quality of a segment was scored as Not acceptable (X), the colorimetric display on the Bull's eye is greyed. (see Figure 4-20).



1. **Segment with tracking quality scored as Not acceptable (X).**

Figure 4-20: Colorimetric display

About the results

Be aware of the following:

- Clinical assessments should be made based on both color and segmental Peak systolic strain values.
- The Save As function is intended for research purposes and should not be used to archive diagnostic data.
- To populate the worksheet and the report the Single Bull's eye screen must be saved.
- All results shown (curves, colors and values) are based on drift compensated values. Any strain drifting is linearly compensated throughout the cycle. If the drift compensation in a given segment is too high, the tracking quality is automatically set to Not acceptable (**X**).
- If the tracking quality was scored as Not acceptable (**X**) in more than one segment, the Global systolic strain value is not calculated.

Reprocessing data

The data from one or several views from a saved AFI analysis may be reprocessed. When reprocessing an AFI analysis a new *Single Bull's eye screen* is created.

1. Double-click on the Bull's eye thumbnail.
   A quad screen is displayed showing the three apical views and the Bull's eye diagram.
2. Select the view to reprocess and perform the analysis as described on page 133.

Vascular measurements

B-Mode measurements

% Stenosis

% Stenosis by diameter

1. Select **Measure**.
2. Open **% Stenosis** in the *Measurement menu*.
3. Select **% Sten (Diam)**.
4. Make a distance measurement of the inner area of the blood vessel.
5. Make a distance measurement of the outer area of the blood vessel.
   The distance measurements and the % Stenosis are displayed in the *Measurement result table*.

% Stenosis by area

1. Select **Measure**.
2. Open **% Stenosis** in the *Measurement menu*.
3. Select **% Sten (Area)**.
4. Make a trace measurement of the inner area of the blood vessel.
5. Make a trace measurement of the outer area of the blood vessel.
   The area measurements and the% Stenosis are displayed in the *Measurement result table*.

Volume

The volume calculation can be made from one, two or three distance measurements.

1. Select **Measure**.
2. Select **Volume** in the *Measurement menu*.
3. When doing volume calculation from three distance measurements (i. e. biplane volume), the measurements should be done in dual mode displaying a sagittal and an axial view. One measurement is usually made in the sagittal plane and two measurements in the axial plane.

When doing volume calculation from one or two distance measurements, make one or two distance measurements and press **MENU** or **CLEAR**.
The distance measurement(s) and the volume calculation are displayed in the *Measurement result table*.

A/B Ratio

In B-Mode, A/B Ratio can be measured by diameter or area.

1. Select **Measure**.
2. Open **A/B Ratio** in the *Measurement menu*.
3. Select between:
   - **Ratio (Diam)**
   - **Ratio (Area)**
4. Make the corresponding two measurements.
   The measurements and the corresponding A/B Ratio are displayed in the *Measurement result table*.

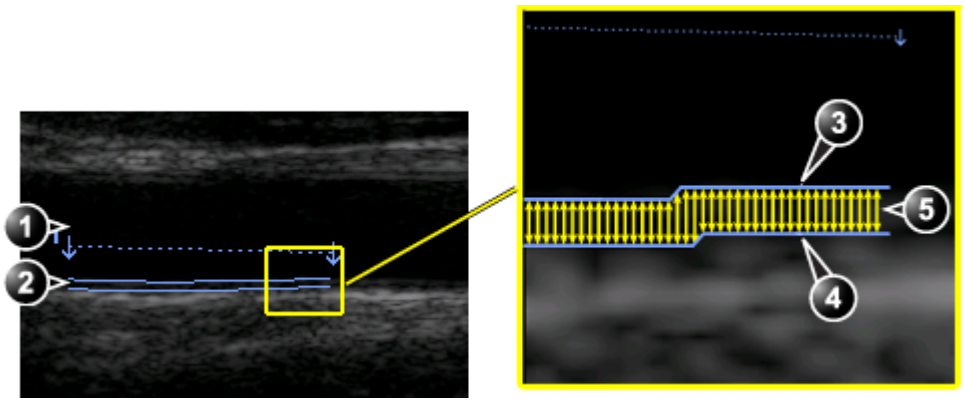
Intima-Media Thickness

The Intima-Media Thickness (IMT) is calculated based on automatic contour detection of the Intima and Media layers on a user-defined search region along the vessel wall. Multiple IMT measurements are made between pairs of intima and adventitia points along the wall (Figure 4-21). IMT can be measured both on the posterior and the anterior walls of the vessel.

Note: due to the physical properties of ultrasound imaging, the posterior IMT measurement is generally more accurate than the anterior IMT measurement.

The following parameters are calculated:

- Average IMT
- Maximum IMT
- Minimum IMT
- Standard deviation of IMT measurements
- Number of successful IMT measurements



1. **Vessel lumen**
2. **Vessel wall**
3. **Lumen-Intima boundary**
4. **Media-Adventitia boundary**
5. **Multiple IMT measurements**

Figure 4-21: IMT measurement (Posterior wall)

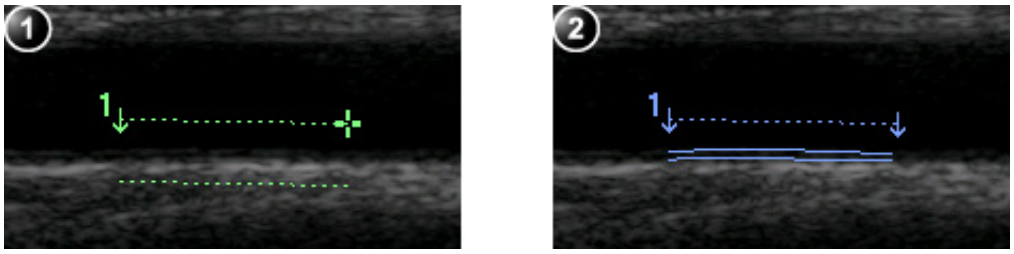
IMT Measurement procedure

The following procedure describes the posterior IMT measurement.

1. Open a longitudinal scan of the carotid artery.
2. Select **Stop**.
3. Scroll to an end-diastolic frame where the intima layer is clearly visible.
4. Select **Measure**.
5. Select the appropriate IMT measurement. If measuring the IMT of the posterior wall of the right common carotid select **Rt** and **CCA IMT Post** (Figure 4-22).

Figure 4-22: IMT Measurement menu (Right Common Carotid Posterior IMT measurement tool)

6. Place the cursor in the artery closer to the posterior wall and press the Left mouse button to anchor the start of the search region (Figure 4-23, left).
7. Move the cursor parallel to the artery to define the end point of the search region. Make sure the Intima and Media layers are within the search region (indicated by the lower dotted line in Figure 4-23, left).
   Press the Left mouse button to anchor the point. For the posterior wall the contour detector searches for the leading of the edges of the intima and adventitia layers. The detected contours are drawn in the image (Figure 4-23, right).
   The measurement calculations are displayed in the *Measurement result Table*.
   Note: if the Intima and Media layers are not within the search region, the contour is not drawn. Select (double click) and move the anchored points closer to the Intima layer.



1. **Measurement segment**
2. **IMT trace**

Figure 4-23: IMT Measurement segment and traces

8. If the contour is not optimal, the following control may be adjusted to improve border detection:
   - **Trace Fit**: the traces are modified according to different threshold values.

   If the contour is still not optimal, try to perform the IMT measurement on another frame, preferably close to the end diastole.

IMT trace approval

Since the IMT measurements are done semi-automatically, the operator has to approve the detection by visual inspection before storing the results in worksheet and report.

1. If the traces fit both layers of the posterior wall, approve the measurement by selecting **Transfer** in the *Measurement menu*.
   Once transferred, the calculations can be viewed in the worksheet and report.
   Note: measurements that are not approved will not be saved.
   Note: any image adjustments (e.g Gain or zoom) on approved (transferred) measurements will unassign the measurements. Press **Transfer** to approve the measurements again.

M-Mode Measurements

% Stenosis

1. Select **Measure**.
2. Select **% Stenosis** in the *Measurement menu*.
3. Make a distance measurement of the inner area of the blood vessel.
4. Make a distance measurement of the outer area of the blood vessel.
   The distance measurements and the % Stenosis are displayed in the *Measurement result table*.

A/B Ratio

In M-Mode, A/B Ratio can be measured by diameter, time or velocity.

1. Select **Measure**.
2. Open **A/B Ratio** in the *Measurement menu*.
3. Select between:
   - **Ratio (Diam**
   - **Ratio (Time)**
   - **Ratio (Velocity)**
4. Make the corresponding two measurements.
   The measurements and the corresponding A/B Ratio are displayed in the *Measurement result table*.

Doppler measurements

The system can detect the trace automatically or the user can draw the trace manually.

Auto vascular calculation

The system performs calculation automatically on the spectrum trace.

The auto vascular calculation can operate in live, freeze or be turned off (**Live**, **Frozen** and **Off** commands in the *Measurements menu*).

From the *Modify Calcs menu*, the user can:

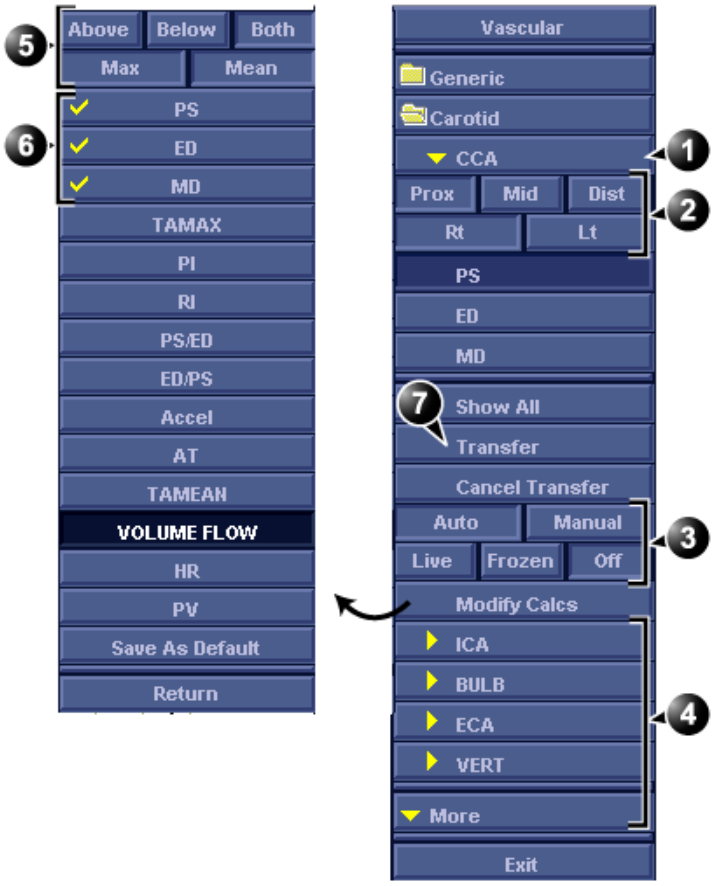
- select the calculations to be displayed in the *Measurement*

result table.

- set the calculations that should be default when an exam is started (**Save as default** command).
- turn on the automatically detected trace to display max and/or mean trace (**Max** and **Mean** commands).
- display forward flow, reverse flow or both flows (**Above**, **Below** and **Both** commands).

Setting up auto vascular calculation

1. Select **Measure**.
   The *Vascular measurement menu* is displayed (Figure 4-24).
2. Press **Auto** and select between:
   - **Live**: calculation displayed on the real-time image.
     Not applicable for EchoPAC PC.
   - **Freeze**: calculation displayed on the frozen image.
   - **Off**: auto vascular calculation is turned off.
3. Press **Modify Calcs**.
   The *Modify Calcs menu* is displayed (Figure 4-24).
4. Select:
   - **Above**, **Below** or **Both** to select the spectrum to perform the calculations on, i. e. above or below the baseline or both.
   - **Max** and/or **Mean** to display max and/or mean velocities.
5. In the *Modify Calcs menu*, select the measurements and calculations to be displayed in the *Measurement result table*.
6. Press **Save as default** to set the selected calculations to be default when a new study or exam is started.



1. **Selected vessel**
2. **Vessel location parameters**
3. **Manual/auto calculation controls**
4. **Other vessels**
5. **Trace parameters**
6. **Selected measurements and calculation to appear in the *Measurement result table*.**
7. **Assign measurement and calculation**

Figure 4-24: Vascular measurement menu (example)

Using Auto vascular calculation

1. Select a vascular Doppler acquisition and press **Measure**.
2. In the *Measurement menu*, select **Auto** and **Freeze**.
   The system performs the calculation automatically and the pre-defined measurements and calculation are displayed in the *Measurement result table*.
3. The following controls may be adjusted from the control panel:

- **Cycle select**
- **Baseline**

Assigning auto calculations

1. In the *Vascular Measurement menu* (Figure 4-24), select:
   - The actual vessel name
   - **Prox**, **Mid** or **Dist**: the location of the vessel (Proximal, Middle or Distal).
   - **Rt** or **Lt**: right or left side of the patient.
2. Press **Transfer** to assign the measurements and calculations.

   The *Measurement result table* is updated accordingly and the measurements and calculations are added to the worksheet and report.

*To undo the assignment, press **Cancel transfer**.*

Manual vascular calculation

When doing manual measurements, the system can detect the trace automatically or it can be drawn by the user. This is controlled by the **Auto** and **Manual** commands is the *Measurement menu*.

1. Select a vascular Doppler acquisition and press **Measure**.
2. Select the measurement to be performed from the *Measurement menu* or from the *Show All menu* for additional measurements.
3. Perform the measurement as described below.

Acceleration, Acceleration time (AT)

1. Select **Accel** or **AT**.
2. Place a caliper to the start point.
3. Place a caliper at the end point.
   The acceleration and/or the acceleration time is displayed in the *Measurement result table*.

Heart rate

Heart rate is calculated by selecting two identical points over four heart cycles.

1. Place a caliper at a recognizable point in the first cycle.
2. Place a caliper at the identical point in the fourth cycle.
   The Heart rate is displayed in the *Measurement result table*.

Peak systole (PS), End diastole (ED) and Mid diastole (MD)

1. Select **PS**, **ED** or **MD**.
2. Place a caliper at the corresponding measurement point.
   The selected measurement is displayed in the *Measurement result table*.

Pulsatility index (PI)

With Auto trace on

1. Select **PI**.
2. Place a caliper at the beginning of the wave form.
3. Place a caliper at End diastole.
   A trace is displayed between the two calipers and PS, MD, ED, TAMAX and PI are displayed in the *Measurement result table*.

With Manual trace on

1. Select **PI**.
2. Place the caliper at the beginning of the wave form.
3. Draw the trace to End diastole.
   The trace is displayed and PS, MD, ED, TAMAX and PI are displayed in the *Measurement result table*.

Peak systole/End diastole (PS/ED) and End diastole/Peak systole (ED/PS) ratio

1. Select **PS/ED** or **ED/PS**.
2. Place a caliper at Peak systole or End systole.
3. Position a second caliper at End diastole or Peak systole.
   The Peak systole, End diastole and PS/ED or ED/PS ratio are displayed in the *Measurement result table*.

Resistive index (RI)

1. Select **RI**.
2. Place a caliper at Peak systole.
3. Place a caliper at End diastole.
   The Peak systole, End diastole and RI are displayed in the *Measurement result table*.

TAMAX/TAMEAN/Volume Flow

With Auto trace on

1. Select **TAMAX**, **TAMEAN** or **Volume Flow**.
2. Place a caliper at the start point.
3. Place the caliper at the end point.

A trace is displayed between the two calipers and corresponding measurements are displayed in the *Measurement result table*.

With Manual trace on

1. Select **TAMAX**, **TAMEAN** or **Volume Flow**.
2. Place a caliper at the start point.
3. Draw the trace to the end point.
   The trace is displayed and the corresponding measurements are displayed in the *Measurement result table*.

OB measurements

1. From an obstetric exam on a scan in Freeze, press **Measure**.
2. Select the desired study.
3. Perform the required measurements from the selected study.
   Follow the on-screen indications when performing measurements.

OB graphs

OB Graphs allow you to assess fetal growth compared to a normal growth curve. When a patient has completed two or more ultrasound exams, you can also use the graphs to look at fetal trending. For multi-gestational patients you can show curves for all fetuses and compare the growth on the graphs. The EchoPAC PC provides the following two basic types of graphs:

- **Fetal Growth Curve graphs** – show one measurement per graph. These graphs show the normal growth curve, positive and negative standard deviations or applicable percentiles, and ultrasound age of the fetus using the current measurement. For multi-gestational pregnancies, you can show curves for all fetuses. If previous exam data is available, the graph can show fetal trending.
- **Fetal Growth Bar graph** – shows the ultrasound age and the gestational age based on patient data. Plots all measurements on one graph.

To view OB graphs

1. Press **Worksheet**.
2. Press **Graph**.
   The Fetal growth curve graph is displayed (Figure 4-25). The horizontal axis shows the fetal age in weeks. The system determines this age from the data entered in the *Patient information window*. Depending on the measurement selected the vertical axis displays measurements (mm or cm), ratios (%) or fetal weight (g). The Fetal growth curve graph shows the following information for the selected measurement:
   - The normal growth curve
   - The standard deviations or relevant percentiles
   - The gestational age of the fetus, using patient data (vertical dotted line)
   - Using the current ultrasound measurement data, where the fetus is on the growth curve

From the OB graphs screen, the user can enter relevant information in the *Fetus position* and *Placenta* fields.

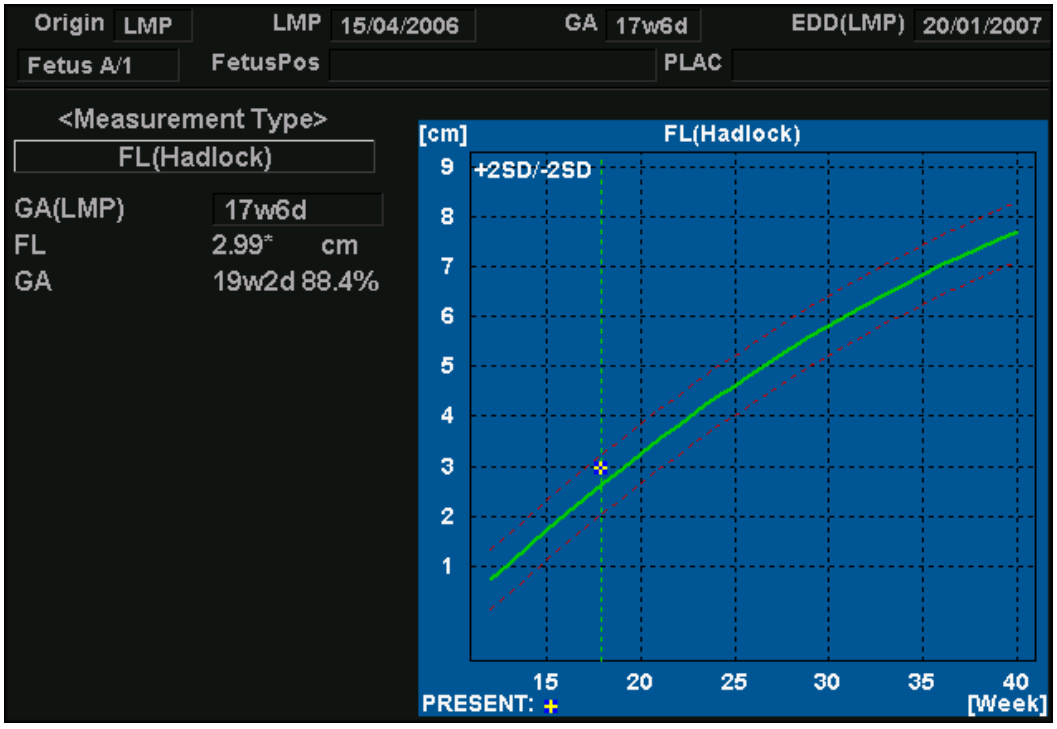


Figure 4-25: Fetal growth curve graph

To select the measurement

1. Select the measurement in the *Measurement type field*. A list of available measurements is displayed.
2. Select the measurement to display.

To edit the Gestational age (GA)

1. Select the **GA (LMP)** value. An editing window is displayed.
2. Enter a new value and select **OK**. The GA (LMP) label is changed to GA(GA) showing the new value entered. This information is also updated in the *Patient information window*. In addition the EDD (LMP) is updated to EDD (GA) with new calculated value.

To view single or quad screen

1. Press **Quad** to display four graphs simultaneously.
2. To select the measurements to display in the quad screen, select the drop-down button on the left of each graph and select the desired measurement.
3. Press **Single** to display single graph screen again.

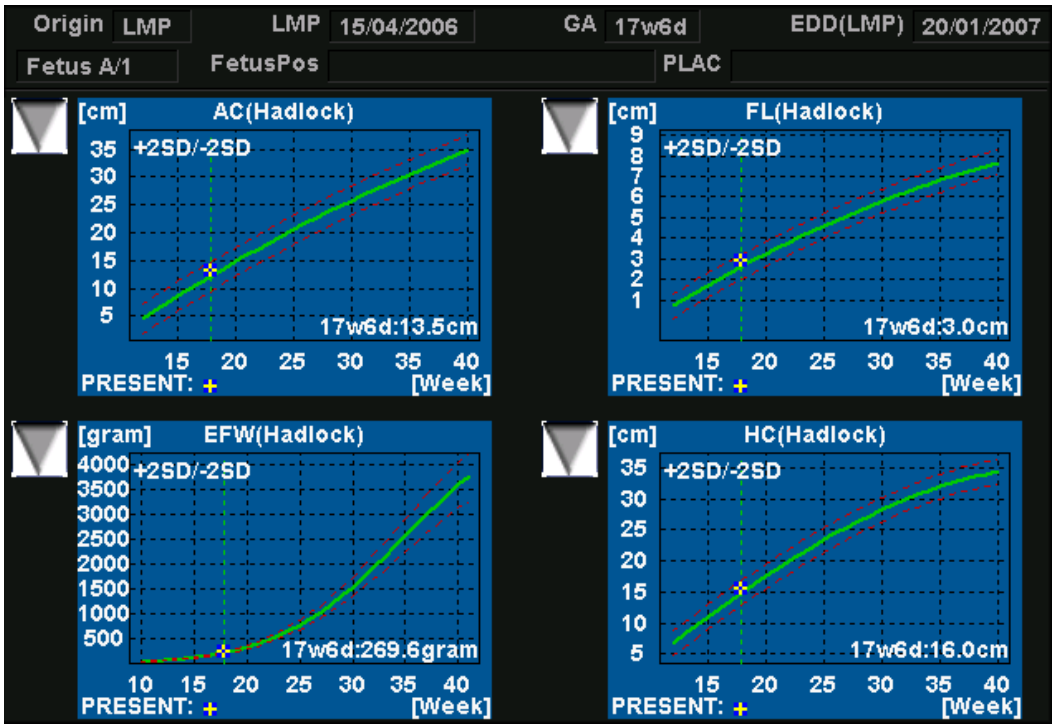


Figure 4-26: Fetal growth curve graph: quad screen

Fetal trending

When you have ultrasound data for more than one exam for a patient, you can use the data to look at fetal trending on the Fetal growth curve graphs. Fetal trending requires that a LMP value is entered in the *Patient information screen*.

1. Press **Worksheet**.
2. Press **Graphs** and select the desired measurement to display.
3. Press **Plot Both**.
   The system automatically finds the data from previous ultrasound exams, and displays it on the graph with the present data.

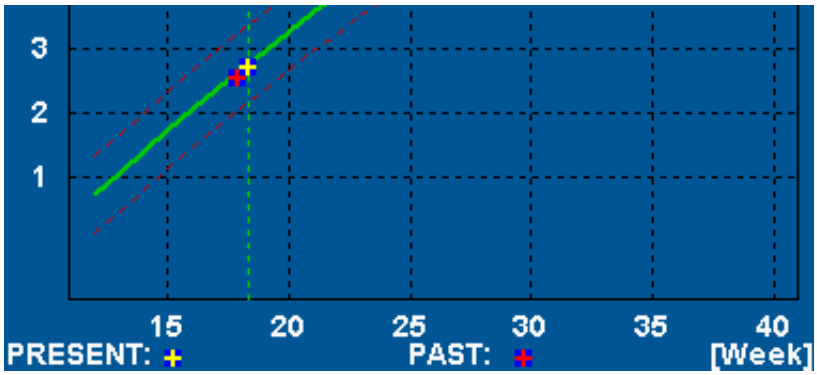


Figure 4-27: Fetal trending graph

Fetal growth bar graph

The fetal growth bar graph shows current exam measurements and the normal growth range based on the gestational age. It shows all measurements on one graph.

1. Press **Worksheet**.
2. Press **Graph**.
3. Press **Bar**.
   The fetal growth bar graph is displayed.

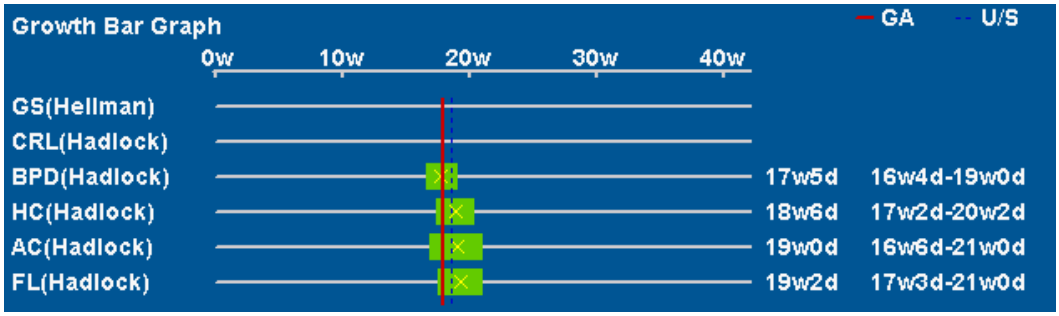


Figure 4-28: Fetal growth bar graph

- The horizontal axis shows the gestational weeks.
- The red vertical line shows the gestational age using the patient data.
- The blue dotted vertical line shows the ultrasound age using the current measurements.
- The yellow x shows the ultrasound age for each measurement.
- The green rectangle shows the normal age range for the measurement.

Measurement package configuration

A list of all cardiac calculations with needed measurements and location in the Measurement package can be found in the Reference manual.

There are many more measurements and parameters in the measurement package than shown in the default *Measurement menu*. Use the configuration system to set up the measurements that should be available in the *Measurement menu* and which parameters should be calculated.

The following example based on calculation of AV CO (Cardiac Output by Aortic Flow) describes how to configure the measurement package so that necessary measurements and the resulting calculations are displayed on screen.

Measurement package configuration - example

Calculation of Cardiac Output by Aortic Flow requires measurement of:

- AV diameter located in the folder *Dimension* (2D mode)
- AV VTI located in the folder *Aortic* (Doppler AV Trace).
- Heart rate

If a calculated parameter (e.g. AV CO in AV Trace measurement) requires another parameter to be calculated (e.g. AV Diam) the user must first measure the required parameter (e.g. AV Diam) before the dependent parameter (e.g AV CO in AV Trace) gets calculated.

Configuration of the Measurement menu

If the AV diameter measurement is not present in the folder *Dimension* in the *Measurement menu*, follow the following procedure:

1. Press **CONFIG** (**F2**) and select the category **Measure**. The *Measurement menu sheet* is displayed (see Figure 4-29).
2. AV Diam is a 2D measurement, make sure that **2D** is checked in the *Measurement sheet*.
3. Select folder **Dimension** in the *Measurement menu*.

A list of all available measurements for the selected folder is displayed in the *Measurement menu sheet*.

4. Check the box in front of **AV Diam**.
   The AV Diam measurement is displayed in the folder *Dimension* in the *Measurement menu*.
5. For the AV VTI measurement, check **Doppler** in the *Measurement menu sheet* and select the folder **Aortic** in the *Measurement menu*.
6. Check the box in front of **AV Trace**.
   The AV Trace measurement is displayed in the folder *Aortic* in the *Measurement menu*.

1. **Select the scanning mode for the measurement to add to the Measurement menu.**
2. **Select the folder for the measurement to add.**
3. **Select the measurement to add.**

Figure 4-29: Configuration of the Measurement menu

Configuration of the Measurement result table

If AV CO calculation is not displayed in the *Measurement result table*, follow the following procedure:

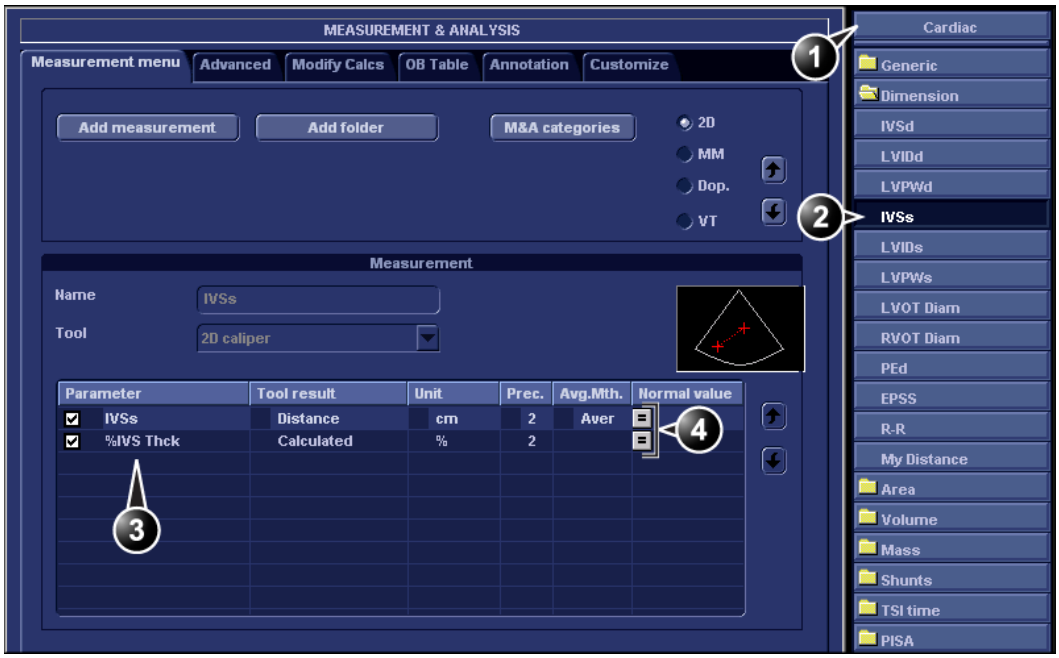
1. Press **CONFIG** (**F2**) and select the Config category **Measure/Text**.
   The *Measurement menu sheet* is displayed.
2. The AV CO calculation is based on Doppler AV Trace measurement in the folder *Aortic*, check **Doppler** in the *Measurement menu sheet* and select the folder **Aortic**.
   A list of all available measurements and calculations for the selected folder is displayed in the *Measurement menu sheet*.
   Note: Entries in green are calculated measurements.
3. In the *Measurement menu sheet*, double-click on the **AV Trace** measurement.
   A list of all available measurements and calculations for the AV Trace measurement is displayed in the *Measurement menu sheet*.
4. Check the box in front of **AV CO**.
   The AV CO calculation will be displayed in the *Measurement result table*.

Normal values

Normal values can be defined by the user for all parameters. A normal value can be either a range or a threshold. Normal values entered are grouped by measurement category (e.g. Cardiac, Pediatrics...etc).

Normal values can be displayed in the report.

To define a Normal value



1. **Measurement category**
2. **Selected measurement**
3. **Parameters**
4. **Press to define Normal value**

Figure 4-30: Adding Normal value

1. Press **CONFIG** (**F2**) and select the Config category **Measure/Text**.
   The *Measurement menu sheet* is displayed (Figure 4-30).
2. In the *Measurement menu*, browse to the measurement of interest.
   The parameters for the selected measurements are displayed in the *Measurement menu sheet*.
   Note: to change Measurement category, press the **Heading** in the *Measurement menu* and select another Measurement category.
3. Select = in the *Normal value column*.
   The *Normal value window* is displayed.

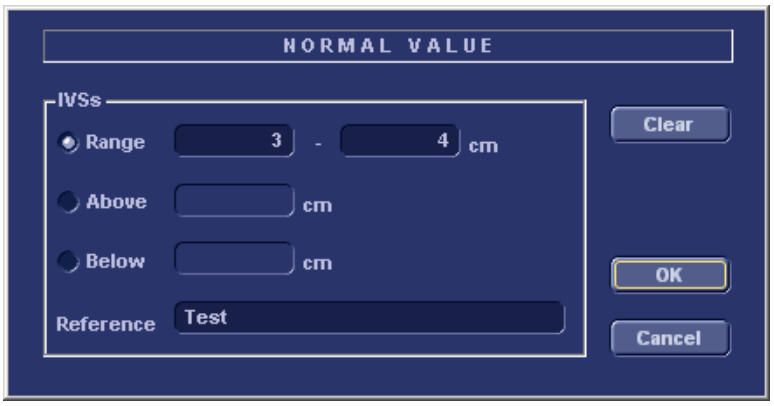


Figure 4-31: The Normal value window

4. In the *Normal value window*:
   - Select the Normal value type (Range, Above or Below).
   - Type in the Normal value.
   - Optionally enter a reference for the Normal value.
5. Select **OK**.
   The Normal value is displayed in the *Measurement menu sheet*.

To display normal values and references in the Report, the Report template must be configured to show Normal values (see page 272). Measurements outside the Normal value are highlighted with an “!” in the report.

User-defined formulas

User-defined formulas can be created using existing measurements or by defining new measurements. The following example describes the creation of a formula based on existing measurements.

△
CAUTION

GE Ultrasound does not take any responsibility for the correctness of the user-defined functions.

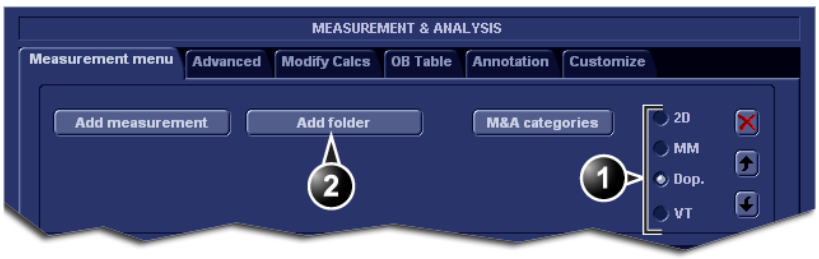
User-defined formula - example

The workflow for user-defined formula is:

- If the user-defined formula is based on several measurements of different types, create a user-defined folder in the *Measurement menu* so that all measurements and the formula are grouped together. If the formula is based on a single measurement you may select an existing appropriate folder.
- Add the measurement(s) needed for the formula to the user-defined (or existing) folder.
- Create the formula based on the added measurements.

The following procedure describes the creation of user-defined LIMP formula as follow: My LIMP = (MCO-AV ET)/AV ET.

Creation of a user-defined folder

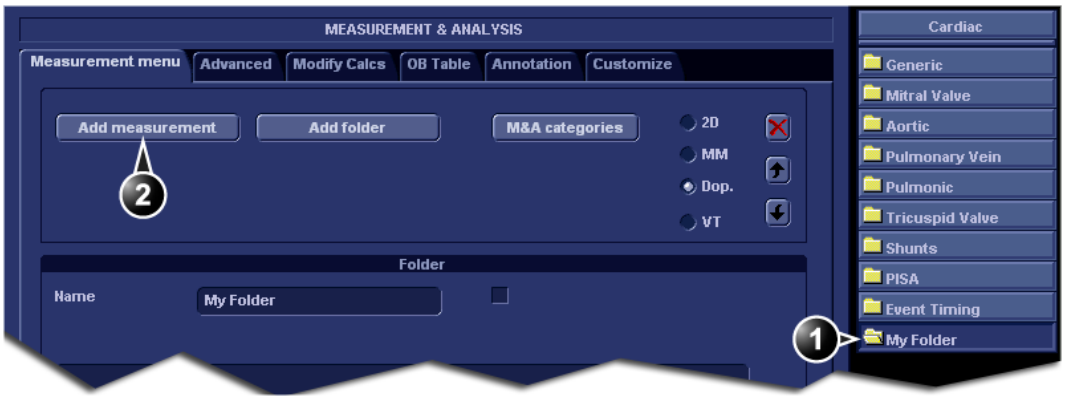


1. **Select the appropriate scanning mode.**
2. **Create a folder in the Measurement menu.**

Figure 4-32: The Measurement menu sheet

1. Press **CONFIG** (**F2**) and select the category **Measure**.
2. MCO and AV ET are Doppler measurements, select **Doppler** in the *Measurement menu sheet*.
3. Select **Add folder**.
4. Give the folder a name (e.g. “My Folder”).

Adding measurements



1. **Select the user-defined folder.**
2. **Press Add measurement.**

Figure 4-33: The Measurement menu sheet

1. Select the user-defined folder (e.g. “My Folder”) in the

Measurement menu.

2. Press **Add Measurement** in the *Measurement menu sheet*.
   The *Add measure window* is displayed.

Figure 4-34: The Add measure window

3. MCO and AV ET are measurements that already exist on the system, check **Use copy of** and select **MCO** from the drop down menu.
4. Select **OK** to add the MCO measurement.
5. Repeat steps 2 to 4 to add the AV ET measurement.

Creation of the formula

1. **Select the last measurement.**
2. **Double click and enter the formula name.**
3. **Select "=" to create the formula.**

Figure 4-35: The Measurement menu sheet

The formula for this example is as follow:
My LIMP = (MCO-AV ET)/AV ET

1. In the user-defined folder (e.g."My folder"), select the last measurement created (e.g. AV ET).
2. Double-click **(Name)** in the last line in the *Parameter list* in the *Measurement menu sheet*.
3. Enter the name for the formula (e.g. My LIMP).
4. Select =.
   The *Edit formula window* is displayed.

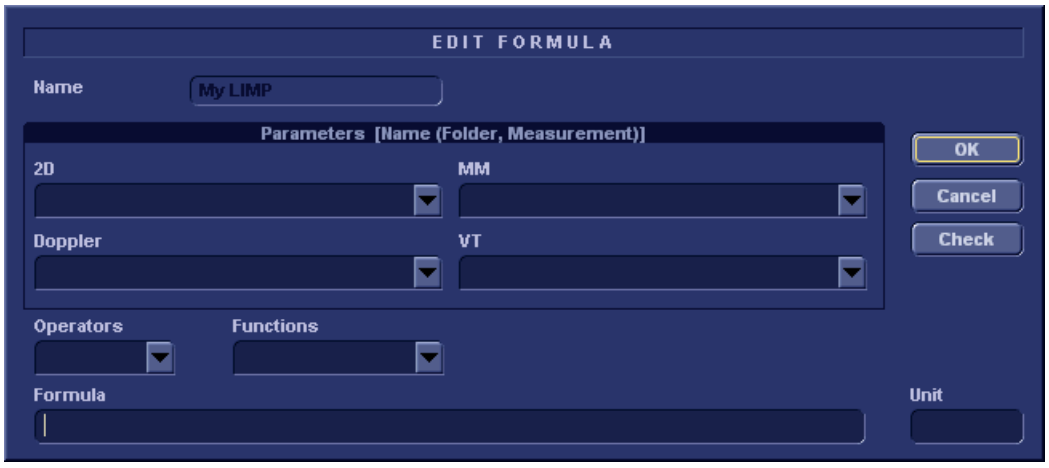
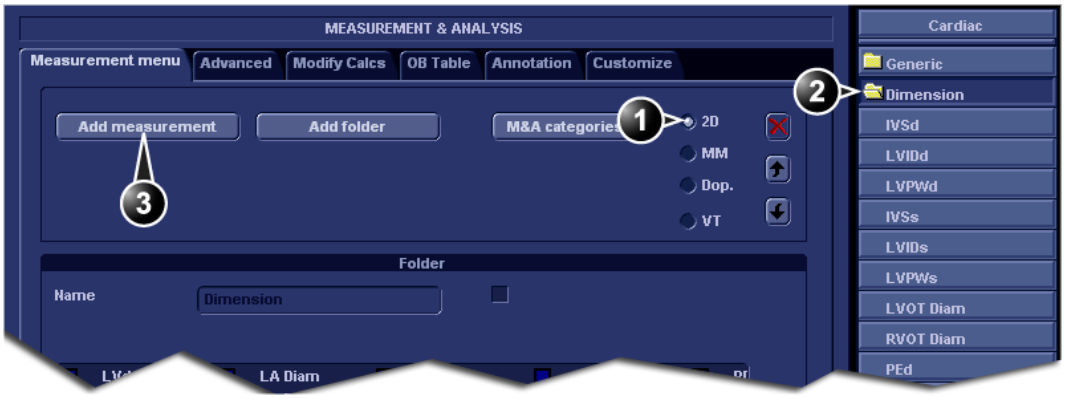


Figure 4-36: The Edit formula window

5. Select “**(**“from the *Operators drop-down menu*.
6. In the *Doppler drop-down list*, select **MCO [My Folder, MCO]**.
   Make sure to select the measurement located in the user defined folder (e.g. “My Folder”).
7. Select “**-**“from the *Operators drop-down menu*.
8. In the *Doppler drop-down list*, select **AV ET [My Folder, AVET]**.
9. Select “**)**“from the *Operators drop-down menu*.
10. Select “*/*“from the *Operators drop-down menu*.
11. In the *Doppler drop-down list*, select **AV ET [My Folder, AVET]**.
    The Formula line should display: *({MCO}-{AVET})/{AVET}*.
    No units are necessary since the formula is a ratio (see also ’About units’ on page 173).
12. Press **Check** to make sure that the syntax for the formula is correct.

User-defined measurements

Some user-defined formula may require measurements that do not exist on the system. The following example based on a generic distance measurement illustrates how to create user-defined measurements.



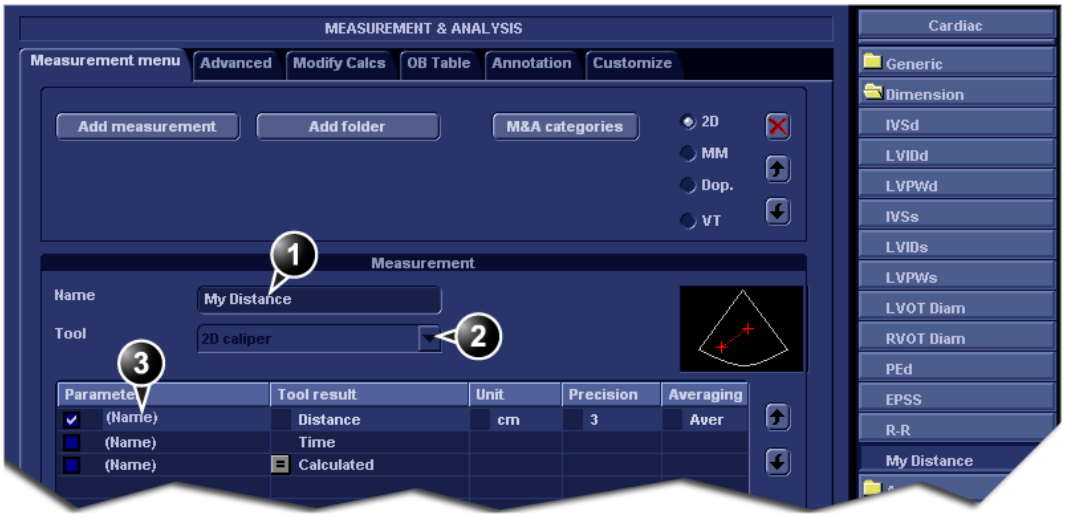
1. **Select the appropriate scanning mode.**
2. **Select the appropriate folder.**
3. **Press Add measurement.**

Figure 4-37: The Measurement menu sheet

1. Press **CONFIG** (**F2**) and select the category **Measure**.
2. In the *Measurement menu sheet*, select the appropriate scanning mode for the measurement to be created (e.g. 2D).
3. Select the appropriate folder in the *Measurement menu* (e.g. Dimension).
4. Press **Add Measurement** in the *Measurement menu sheet*.
   The *Add measure window* is displayed.

Figure 4-38: The Add measure window

5. Check **Blank** and press **OK**.
   The *Measurement menu sheet* is updated.



1. **Enter a name for the measurement.**
2. **Select the appropriate measurement tool.**
3. **Double click and enter the formula name.**

Figure 4-39: The Measurement menu sheet

6. In the *Measurement menu sheet*, enter the name for the measurement (e.g. My Distance).
7. Select the appropriate measurement tool in the drop-down menu, next to **Tool** (e.g. 2D Caliper).
8. Double-click **(Name)** in the appropriate parameter (e.g Distance) and enter a name for the parameter (e.g. My Length).
   If desired change the unit and the number of decimals for the measurement by double clicking the values under *Unit* and *Precision* (see also 'About units' on page 173).

About units

Be aware of the following:

- All formulas are calculated in SI units (see table below).
- If no unit is specified in the *Edit formula window* when defining a formula, the displayed value will be in SI unit.

To define a different unit

1. When creating a formula, enter the unit to use when displaying the formula output. E.g. if Y in the formula Y=f(x) is to be displayed in cm, enter cm in the *Unit* field.
   The *Unit* field is case sensitive, make sure to enter the exact unit as shown in the table below (Alternative unit column).
2. The output of a formula must always be in an SI unit (see table below). Conversion to the specified display unit is then done automatically.
   Example: an user wants to add a regression formula for estimating a length **B** from a measured length **A**, both in cm.
   The formula is: B = 2.4 + 1.1*A.
   - As **A** is a measurement value the system will enter the formula in the SI unit for length (m). The formula expects **A** in cm, and to get that, **A** must be multiplied by 100:
     B = 2.4 + 1.1*A***100**
   - The formula now gives **B** in cm. Converting the output from cm to the SI unit (m), is done by dividing by 100:
     B = (2.4 + 1.1*A*100)**/100**

   The output is now in m, and by entering this formula into the system the user gets the expected result. Measuring an **A** of 2 cm gives:
   B = (2.4 + 1.1*0.02*100)/100 = 0.046 m.
   Before display of the value it is converted according to the specified display unit (cm), and the system displays 4.6 cm. If the selected display unit was set to mm the formula would give the exact same output, 0.046 m, but the automatic unit conversion would now instead give a displayed value of 46 mm.

Calculation	SI	Alternative unit
Time	s	ms - msec - min - h
Ratio	%	
Frequency	bpm	
Angle	rad	deg - grad

Calculation	SI	Alternative unit
Distance	m	cm - dm - cm - mm - inch - feet- pixels
Velocity	m/s	dm/s - cm/s - mm/s - inch/s
Acceleration	m/s^2	dm/s2 - cm/s2 - mm/s2 - inch/s2
Area	m^2	dm2 - cm2 - cm^2 - mm2 - inch2
Volume	m^3	dm3 - cm3 - l - dl - cl - ml - gallon - quart
Volume flow	m^3/s	dm3/s - cm3/s - l/s - dl/s - cl/s - ml/s - m3/min dm3/min - cm3/min - l/min - L/min - dl/min cl/min - ml/min - ml/m2
Pressure	mm Hg*	Pa - kPa - bar - torr - atm - psi
Pressure/time	mm Hg/s	mmHg/s
Mass	kg	g - ounce - pound
Other		mmHG - Date - WeekDay - Day - NoUnit l/minm2 - g/m2 - cm/m2
* The correct SI unit for pressure is Pa, but here mm Hg was used as base unit as it is a standard pressure unit to use in medicine.		

Controlling the Measurement result table display

The display of the *Measurement result table* can be minimized and moved to prevent the table obscuring parts of the ultrasound image.

Minimizing the Measurement result table

1. Move the **Mouse cursor** to the symbol on the heading of the *Measurement result table* (see Figure 4-40).
2. Press the **Left mouse button**.
   The *Measurement result table* is minimized to the heading bar.

Repeat step 1 to enlarge the ***Measurement result table****.*

Moving the Measurement result table

1. Move the **Mouse cursor** to the symbol on the heading of the *Measurement result table* (see Figure 4-40).
2. Press the **Left mouse button** to grab the table.
3. Move the *Measurement result table* to a new position.
4. Press the **Left mouse button** to anchor the table.

1. **Minimize/maximize table**
2. **Move table**

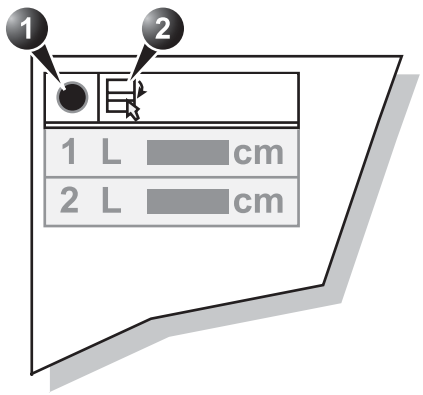


Figure 4-40: Measurement result table display tools

Chapter 5
Stress echo analysis

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Introduction

EchoPAC PC provides an integrated stress echo package, with the ability to review, perform wall segment scoring and report for a complete efficient stress echo analysis. Users can define various quad screen review groups, in any order and combination, that will suit their normal review protocol.

The stress package provides protocol templates for exercise, as well as, pharmacological stress examinations. In addition to preset factory protocol templates, templates can be created or modified to suit users' needs. Users can define various quad screen review groups, in any order and combination, that will suit their normal review protocol. When reviewing stress examination images, the images are viewed at their original image quality, and different post-processing and zoom factors may be applied to the images under review for effective image optimization. In addition to standard wall motion scoring analysis, the user can perform quantitative stress analysis based on tissue velocity information (TVI).

Review of protocol studies

Image acquisitions based on a protocol study (e.g. stress echo examinations) can be reviewed from the *Protocol screen* (see Figure 5-1).

1. **Projection selection**
2. **Selected loops**
3. **Level selection**
4. **Group of views**

Figure 5-1: The Protocol screen

Selecting images for analysis

Images can be selected manually or from a pre-defined group in the *Protocol screen* (Figure 5-1).

Selection of images from a group

If groups of images have been defined in the protocol template (see page 198), the user can select a group of images for

analysis and sequentially analyze all images from all groups from within the *Image analysis screen* (see page 182).

1. Move the **Mouse cursor** over the group in the *Group list* to select the images.
   Both the group name and the belonging images are highlighted.
2. Select the group to start analysis of the selected group of images.

1. **Select a Projection**
2. **Select an image**
3. **Select and open an Image group**

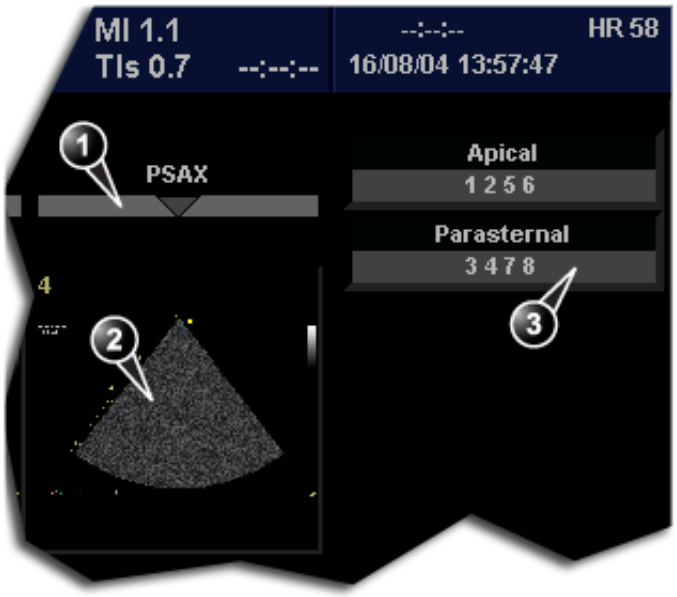


Figure 5-2: Image selection from the Protocol screen

Manual selection of images in the Analysis screen

1. When currently in protocol analysis in the *Stress analysis quad screen* (Figure 5-3, page 182), hold down **Shift** while performing steps 2 and 3.
2. Select the first image in the *Template matrix*.
   The selected loop is displayed in the *Stress analyze screen* and the next window in the quad screen is automatically selected.
3. Repeat step 2 to select other images.

4. Depress **SHIFT**.

Manual selection of images in the Protocol screen

To select a level (or a projection), click on the selection button close to the heading, see Figure 5-1.

1. In the *Protocol screen*, click once on the images of interest. The selected images are displayed with a highlighted frame (see Figure 5-1).
2. Select **Analyze** to start analysis.

Loop synchronization

To select a level (or a projection), click on the selection button close to the heading, see Figure 5-2.

1. In the Protocol screen, select the loop to synchronize.
2. Click **Sync. Selected**.

Stress echo analysis

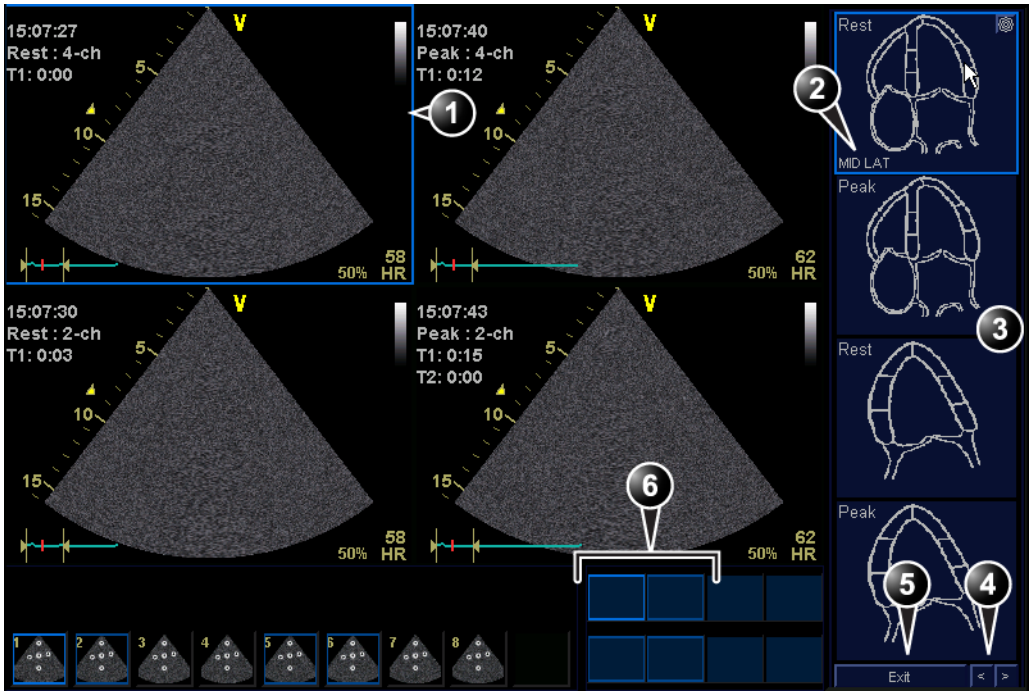
Stress echo analysis consists of viewing previously saved loops and assigning a score to each cardiac segment, in order to quantify the function of the muscle.

The usual procedure consists of sequentially opening all image groups and perform scoring from image to image.

Starting analysis

Up to 12 cineloops can be displayed simultaneously.

1. From The *Protocol screen* (see Figure 5-1, page 179), select the first image group (see page 179).
2. press **Start Analysis**.
   The *Stress Echo analysis screen* is displayed (see Figure 5-3) showing the first four images and the corresponding scoring diagrams.



1. **Selected loop (highlighted frame)**
2. **Highlighted segment name**
3. **Wall segment diagrams**
4. **Change page or enter next image group**
5. **Exit Wall motion scoring**
6. **displayed loops (highlighted frames)**

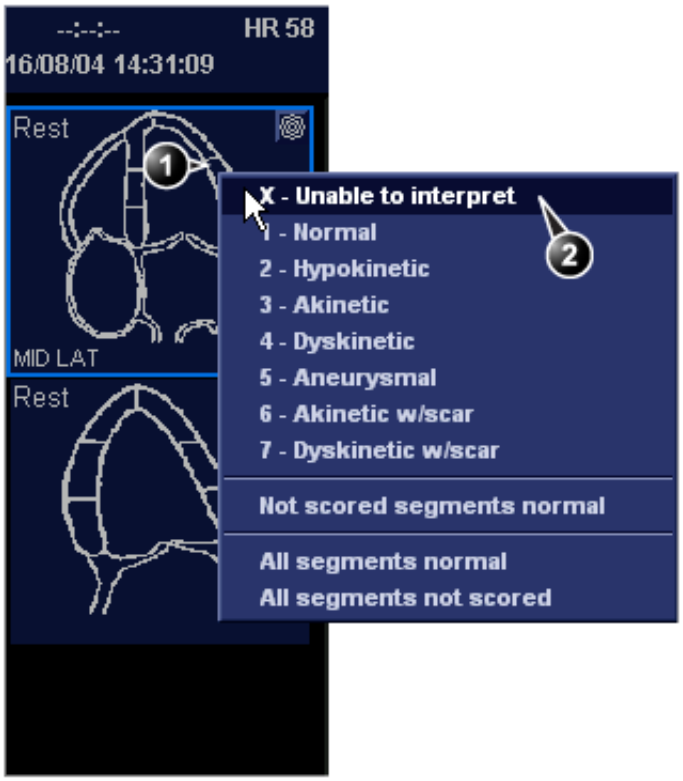
Figure 5-3: The Stress Echo Analysis screen

Scoring

1. Click on a **segment** in one of the scoring diagrams. The *Score popup list* is displayed (see Figure 5-4).
2. Select the **score** from the *Score popup list*. The score is displayed in the relevant segment area in the diagram.
3. Repeat steps 1 through 3 to score relevant segments.
4. Press **Next page** ▷ to access to the next images in the group or to the next group.

If the segment scored is displayed in more than one diagram, the score is displayed in the other diagram(s).

1. **Selected segment**
2. **Selected score**



1. **Scored segment**

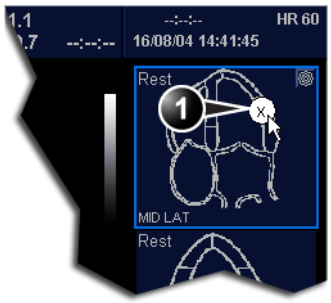


Figure 5-4: Segment scoring

Image optimization

During analysis, the user can adjust the images by exiting the *Stress Echo analysis screen*.

To optimize images

1. Press **Exit** in the *Stress Echo analysis screen*.
   The *2D control panel* is displayed.
2. Select a loop.
3. If necessary, deselect **Run Cineloop** to freeze the image and scroll through the cineloop using the **Frame slider** to display the desired image.
4. Check **Apply to all** if global adjustment is desired.
5. Adjust the image controls to optimize the display.

Zoom function

The image can be magnified as described in ’Zoom function’ on page 86.

Quantitative TVI Stress echo analysis

WARNING

QTVI Stress analysis is meant as a guide to wall motion scoring.

Diagnosis must not be based on results achieved by QTVI Stress analysis only.

EchoPAC PC provides a Quantitative TVI (QTVI) Stress analysis package based on Tissue velocity information (TVI). The TVI data is stored in a combined format with grey scale imaging during stress examination.

When selecting a template supporting TVI data acquisition, the ultrasound unit will automatically store TVI information, generally for the apical views of the stress examination.

The QTVI Stress analysis option currently applies only to Dobutamine stress-echo.

Wall Motion Scoring remains the basis for the diagnosis of CAD in stress echocardiography. QTVI Stress may be used as a guidance tool to check this interpretation.

The current version of QTVI Stress is based on the assessment of peak velocity at peak dobutamine stress (see reference 1 on page 192). The normal ranges have been validated in the “average” patient presenting for stress testing. The velocity cutoff values for the Vpeak measurement will not work in the following cases:

- Submaximal stress (<85% predicted max HR)
- Patients at extremes of age (<40 or >70)
- Previous myocardial infarction / revascularization
- Previous heart-failure / cardiomyopathy / hypertrophy / arrhythmia / aortic regurgitation

Velocity measurements in mid and basal segments of the myocard will contain contributions from the apical region of the myocard. E.g. if measured value in a mid segment is below the cutoff value for this segment then this might relate to a reduced function in the mid or apical region.

The velocity cutoff values are based on placing the sample volume at center of each cardiac segment at start of systole, the left ventricle myocardial segments are defined by the American Society of Echocardiography 16 segments model. However, the velocity cutoff model does not cover the apical segments (due to low velocities and segment orientation), (see side note).

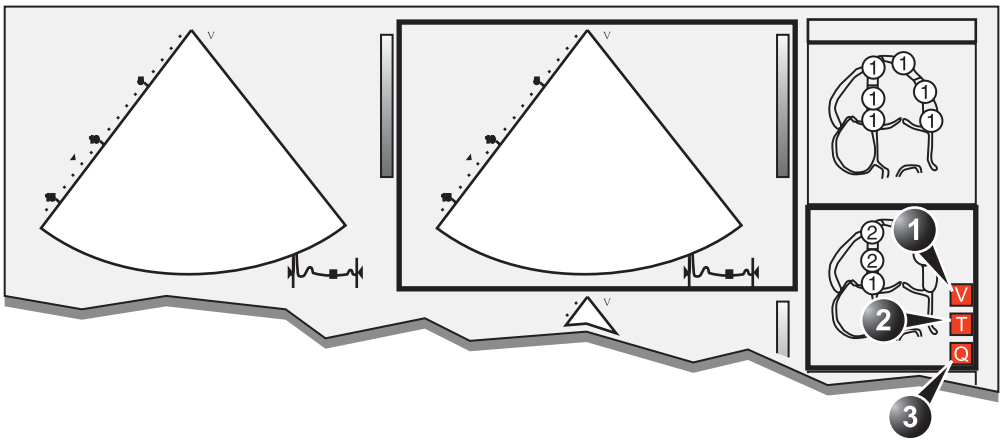
Tissue Doppler does not have perfect site-specificity because of tethering by adjacent segments. Thus, although an ischemic segment has little thickening (and therefore could be expected to show low velocity), measured velocity may be influenced by local tethering, reflecting contraction in surrounding segments. Conversely, a normal segment may have its velocity reduced by an adjacent segment with reduced velocity. This tethering effect may decrease the sensitivity for single vessel disease, but nonetheless the sensitivity and specificity of the cut-offs are approximately 80% (see reference 1 on page 192).

Three different analysis tools based on TVI data are available:

- **’Vpeak measurement’ on page 188**, enables the display of a tissue velocity trace for a selected region of a previously scored segment through the entire heart cycle. In addition Vpeak is color-coded on the 2D image. From the velocity trace, the user can estimate the peak systolic velocity (see reference 1 on page 192). This tool is available in views from peak levels only and only when a segment has been scored in one of these views.
- **’Tissue Tracking’ on page 191**, enables visualization of the systolic contraction of the heart by color-coding the myocardial displacement through the systole.
- **’Quantitative analysis’ on page 192**, enables further quantitative analysis based on multiple tissue velocity traces. The quantitative analysis is described in Chapter 6, ’Quantitative Analysis’ on page 201.

Accessing QTVI Stress analysis tools

The three QTVI Stress analysis tools are entered by pressing a dedicated button on the scoring diagram (see Figure 5-5) of the selected view. Only views with TVI data acquired will display QTVI Stress tools buttons on the respective diagrams.



1. **Vpeak measurement (V-peak measurement is displayed in views from peak levels and only after scoring.)**
2. **Tissue Tracking**
3. **Quantitative analysis**

Figure 5-5: Q-stress tools buttons

Vpeak measurement

This tool enables the user to generate a tissue velocity profile for a given wall segment through the entire heart cycle and display color-coded Vpeak in tissue. From the velocity trace, the user can determine whether the systolic Vpeak is over or under a clinically determined velocity threshold (see reference 1 on page 192) to confirm the wall motion scoring.

△
CAUTION

QTVI Stress can be used only in conjunction with wall motion scoring analysis, as a guiding tool.

When activating QTVI Stress, the measurement applies only to the latest completed scoring, i.e. for a particular segment at a given level and projection view. The scoring bullet in the segment is highlighted accordingly.

To display a Vpeak measurement

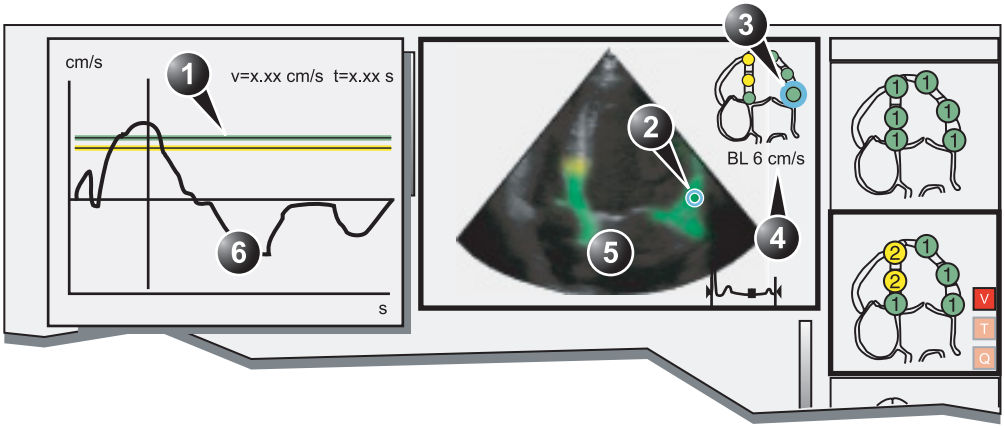
1. Perform segment scoring as described on page 183. When performing scoring i a view from a peak level, the Vpeak measurement button (**V**) is displayed in the corresponding diagram.
2. In the *Scoring diagram*, press **V**.
   The trackball cursor is changed to sampling area and the scored peak views are updated showing:
   - A diagram with the current segment highlighted (scoring bullet with a ring) and the segment's velocity cutoff (see Figure 5-6).
   - Color-coded velocity in tissue. The color-coding convention is as follow:
     - **Green**: Velocities above threshold value + 5%
     - **Yellow**: Velocities near threshold (+/- 5% interval)
     - **White**: Velocities below threshold value - 5%
3. A result window to display tissue velocity profile, shown when moving the sampling area in the view.
4. In the 2D sector, move the sampling point over the wall area corresponding to the current segment (shown as the highlighted segment in the diagram).
   A tissue velocity profile for the actual segment is generated in the *Result window* (see Figure 5-6).
5. Press **Next** or **Previous** to analyze other segments in the peak view,
   OR
   Select another **scoring bullet** in the diagram in one of the peak views.

See page 190 for further information on Vpeak measurement interpretation.

Turn-off the Vpeak measurement tool

1. Select the **V** button in one of the peak view scoring

diagrams.



1. **Threshold for current segment (green)**
2. **Sampling point**
3. **Current segment**
4. **Vpeak threshold for current segment**
5. **Color-coded tissue velocity:**
6. **Result window with tissue velocity profile**

Color-coding (velocity thresholds and tissue):

- **Green: velocities above threshold value**
- **Yellow: velocities near threshold (0 to -10% interval)**
- **White: velocities below threshold value - 10%**

Figure 5-6: Vpeak Q-stress display

V-peak measurement interpretation

The systolic Vpeak in the tissue velocity profile is automatically detected and highlighted by a vertical bar (see Figure 5-6). The automatically detected Vpeak should be visually verified by the user. In addition Vpeak thresholds are displayed as color-coded horizontal lines. These thresholds represent statistical guideline values for peak velocity at peak stress level (Dobutamine stress procedure) for the three apical views. Only threshold values for basal and mid-segments for each apical view are defined (see reference 1 on page 192). The result is highlighted by a color-coding of the thresholds lines, the color-coding in the 2D image and the scoring bullet (see Figure 5-6).

Tissue Tracking

Tissue Tracking calculates and color-codes the displacement in tissue over a given time interval. The displacement is found as the time integral (sum) of the tissue velocities during the given time interval. The color-coded displacements calculated in the myocardium are displayed as color overlay in the respective acquisition window.

By studying the color patterns generated in the different segments, the user can confirm the standard segmental wall motion scoring (see page 183) at peak levels.

To display Tissue Tracking

1. Select a loop with TVI data (usually an apical view at peak level).
2. In the corresponding *Wall segment diagram*, press **T** (see Figure 5-5, page 188).
   The Tissue Tracking color overlay is displayed in the acquisition window.

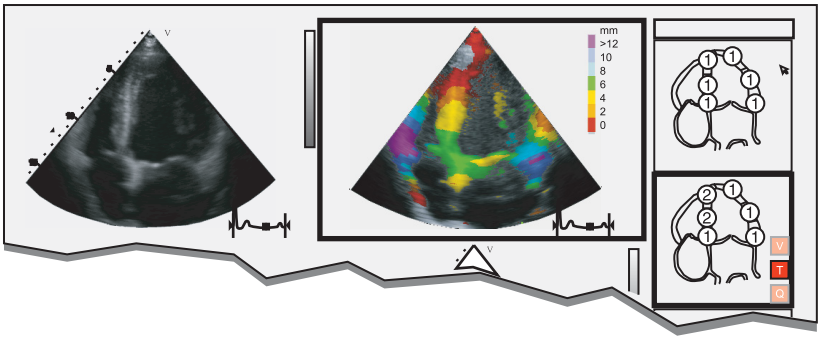


Figure 5-7: Tissue Tracking display

Quantitative analysis

Quantitative analysis enables further analysis based on multiple tissue velocity traces. Quantitative analysis is performed using the Quantitative analysis package described in Chapter 6, 'Quantitative Analysis' on page 201.

To start quantitative analysis

1. Select a loop with TVI data (usually an apical view at peak level).
2. In the corresponding **Wall segment diagram**, press **Q** (see Figure 5-5, page 188) to launch the Quantitative analysis package (see page 204).

References

1. **Application of Tissue Doppler to Interpretation of Dubotamine Echocardiography and Comparison With Quantitative Coronary Angiography.** Cain P, Baglin T, Case C, Spicer D, Short L. and Marwick T H. *Am. J. Cardiol. 2001; 87: 525-531*

Editing/creating a template

The stress package provides protocol templates for exercise as well as pharmacological stress examinations. The user can create new templates or modify existing templates to suit the individual needs. Up to ten projections and fourteen stress levels can be created in a template.

The templates created can be used for acquisition on the scanner. The editing that may be performed includes:

- Adding/deleting levels and projections, see page 197.
- Assigning new labels to levels and/or projections, see page 198.
- Defining level options, see page 198.
- Defining new image groups, see page 198

Templates are edited/created from the *Template editor screen*.

Template editor screen overview

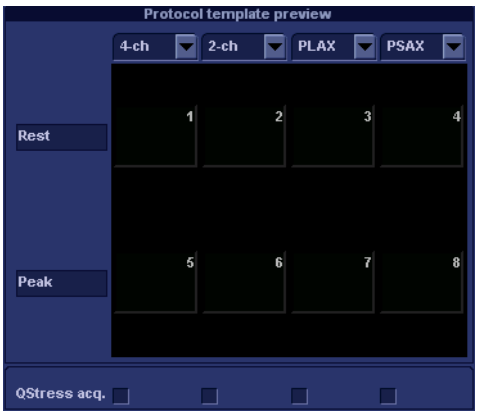
1. In the *Protocol screen*, select **Template Editor**.
   The Template Editor screen is displayed (see Figure 5-8).

Figure 5-8: The Template editor screen

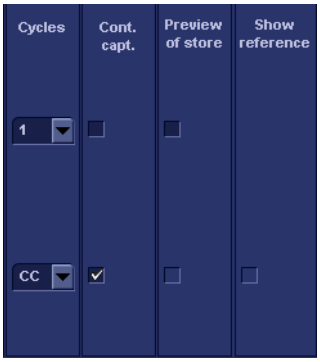
Template

Parameter	Description
	Template: • select a pre-defined template from the pop-up menu. The *Protocol template preview* (see below) is updated accordingly.

Protocol template preview

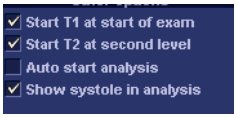
Parameter	Description
	**Protocol template preview:** • Displays an updated preview of the template accordingly to the settings applied. • To edit *Projection* and *Stress level labels*, select a pre-defined label from the pop-up menu or click on the label to edit and type a new name.

Template settings

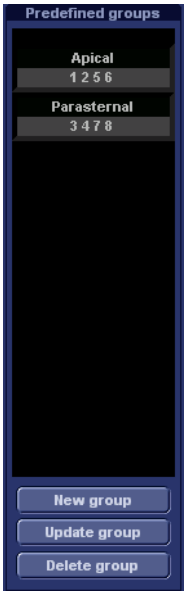
Parameter	Description
	**Template settings:** • **Cycles**: selects the number of cineloop heart cycles to store for each level from the drop-down menu. • **Continuous capture**: ☑: enables continuous image acquisition throughout the level. The images acquired are temporarily stored in the unit's storage buffer. • **Preview of store**: ☑: enables review and adjustment of cineloops before storage. • **Show reference**: ☑: displays a dual screen with the reference level (first or previous level) on the left and the live image on the right.

Other options

Parameter	Description
	Grid size: • Enter the number of levels and projections for the selected template.

Parameter	Description
 	**Timers:** • ☑: starts T1 and T2 timers automatically **Auto-start analysis:** • ☑: displays the *Stress Echo Analysis screen* when the last acquisition is performed. **Smart Stress:** • ☑: stores a subset of the image acquisition settings (geometry incl. zoom, gain, compress, reject, power...etc) for each view in the protocol. Smart Stress enables to set image acquisition settings for each view at baseline level and automatically get the same image settings in the corresponding views in the next levels. In Continuous capture acquisition at peak stress, the active cell must be moved manually through the views using the arrow buttons (or foot pedal).
	Reference image: • When **Show Reference** is selected (see page 195), selects either corresponding baseline loop or corresponding loop from the previous level to be displayed as reference image during acquisition.

Pre-defined groups

Parameter	Description
	**Pre-defined groups:** • Shows the image groups created. • **New group**: creates a new image group. Select the desired images on the template preview (see page 198). • **Update group**: edits a selected group after new loop selection on the template preview (see page 199). • **Delete group**: deletes selected group (seepage 199).

Selecting a base template to edit

Determine the required number of projections and levels you need and select the most appropriate foundation template.

1. Select the **template** to edit in the *Template popup menu*. The selected template is displayed in the *Protocol template preview field*, showing the levels and projections and their labels (see Figure 5-8).

Adding/deleting levels and projections

1. Enter the number of levels and projections in the *Grid size field* (see Figure 5-8).
   The new grid size is displayed in the *Protocol template preview field***.**
2. Press **New Template** to create a new template.
   OR
   Press **Save Template** to update the base template.

Display timer(s)

The timers can also be started or stopped at any time during stress examination using the assignables T1 and T2 on the control panel.

1. Check the box(es) to display timer(s) as specified (see Figure 5-8).

Start analysis automatically

1. Check **Auto start analysis** to display the *Stress Echo Analysis screen* when the last acquisition is performed.

Assigning new labels to levels and projections

1. In the *Protocol template preview field*, select a pre-defined label from the pop-up menu
   OR
   double-click on the **Label** to highlight the text that is to be changed and type a new name.

Configuring levels

*After configuration, press either **New Template** or **Update Template**.*

The following options can be set up for each level:

Number of cycles to be stored in the cineloop:

1. Enter the desired number in the *Cycles field*.
   Up to four cycles/cineloop can be stored.

Continuous capture

1. Check **Continuous capture** if continuous image acquisition throughout the level is desired.
   When Continuous capture is selected, preview of cineloop and reference display (see below) during acquisition are not possible.

Preview of store

1. Check **Preview of store** if review and adjustment of cineloops before storage is desired.

Show reference

1. Check **Show reference** if the display of the corresponding reference loop is desired during acquisition (dual screen mode).

Adding a group

1. In the *Protocol template preview field* select the cells to be part of the group.
2. In the *Pre-defined group field*, press **New group**.

A dialogue box is displayed asking the user to enter a name for the new group.

3. Enter the group name.
4. Press **OK**.
   The new group is displayed in the *Pre-defined group field*.

Updating an existing group

A selected group is highlighted by a yellow frame.

1. In the *Pre-defined group field*, select the group to edit.
   The selected cell are highlighted in the *Protocol template preview field*.
2. Either select (a) new cell(s) to add to the group or deselect (an) existing cell(s) to remove from the group.
3. Press **Update group** in the *Pre-defined group field*.
   The display in the *Protocol template preview field* is updated accordingly.

Deleting a group

A selected group is highlighted by a yellow frame.

1. In the *Pre-defined group field*, select the group to delete.
2. Press **Delete group**.
   The group is removed from the list in the *Pre-defined group field*.

Chapter 6
Quantitative Analysis

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Introduction

The quantitative analysis software package is designed for analysis of TVI, Tissue Tracking, Strain, Strain rate and Contrast related raw data.

The main features of these options are:

For TVI:

- Multiple Time -motion trace display from selected points in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Tissue Tracking:

- Multiple tissue displacement trace display from selected segments in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Strain rate:

- Multiple Strain rate (Rate of deformation (s-1)) trace display from selected segments in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Strain:

- Multiple Strain (extend of tissue deformation (%)) trace display from selected segments in the myocardium.
- Arbitrary Curved anatomical M-Mode

For Contrast:

- Time-Intensity analysis from multiple region of interest
- Curve fitting
- Arbitrary Curved anatomical M-Mode

If not otherwise specified, the topics described in this chapter are applicable for both TVI and contrast data.

Accessing the Quantitative analysis package

The Quantitative Analysis application is entered from the *Image analysis screen* (see page 72).

1. In the *Image analysis screen*, select a TVI or Contrast acquisition.
2. Press **Quantitative Analysis**.
   The *Quantitative analysis screen* is displayed.

Overview

1. **Color cineloop window**
2. **Tissue cineloop window**
3. **Analysis window**
4. **Sample Area**
5. **Time at cursor position and velocity at cursor position**
6. **Control panel**
7. **Sample area tools**

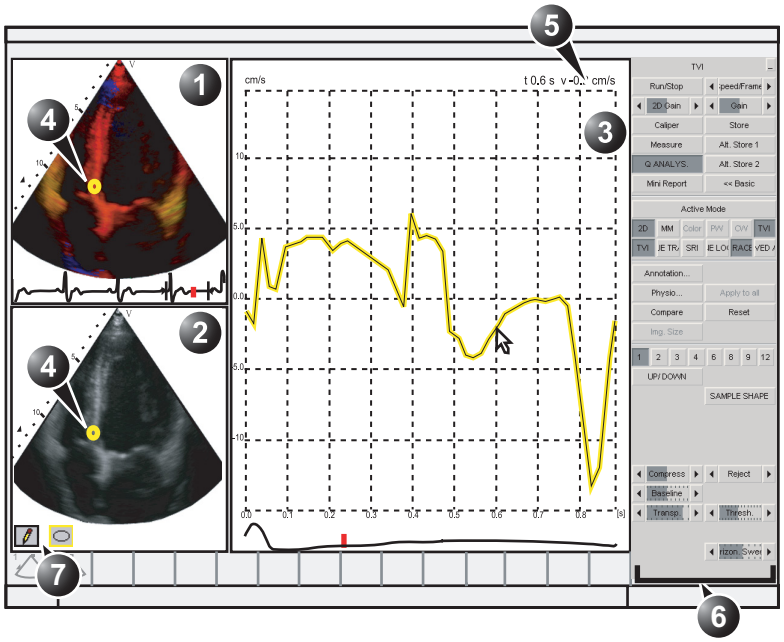
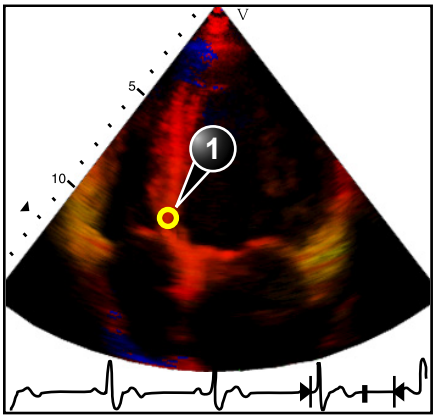
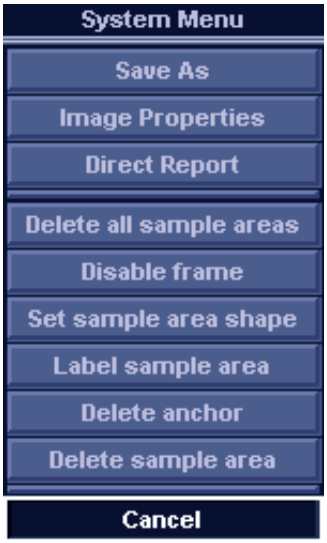


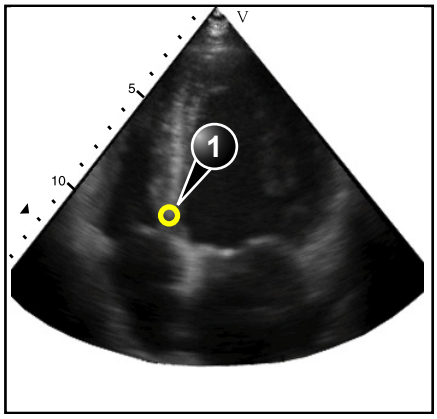
Figure 6-1: The Quantitative analysis window (here with TVI data)

The color cineloop window

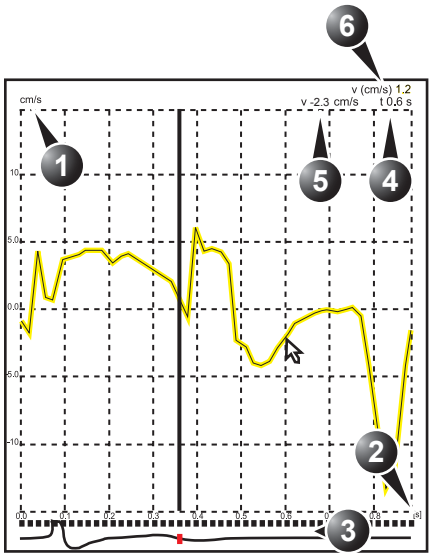
<table>
<tr>
<td> 
</td>
<td>Displays TVI, Tissue Tracking, Strain, Strain rate or Angio color-coded data.
Sample area (1):
Indicates sampling position of the velocity (TVI), displacement (Tissue Tracking), percent deformation (Strain), deformation rate (Strain rate) or intensity (Contrast) trace. The sample area is color-coded: the first sample area is yellow, the second green...etc.</td>
</tr>
<tr>
<td> 

a) Shown only when a sample area is selected (pointed at).
b) With Contrast data only.
c) Shown only when pointing at an anchored sample area.</td>
<td>The cineloop windows system menu
This menu is entered by pressing the right mouse button when the cursor is within one of the Cineloop windows.
• Delete all Sample areas: removes all traces at once.
• Disable frame[b]: the current frame is excluded from the cineloop display.
• Set Sample area Shape[a]: enables resizing of a selected sample area by setting height, width and tilt angle. The trackball marker must be pointed at an anchored sample area.
• Label Sample area...[a]: set a descriptive name to the sample area. The label is useful for identification of the sample area when exporting data.
• Delete anchor[c]: remove anchoring from a dynamic sample area (see also page 212 and page 213).</td>
</tr>
<tr>
<td></td>
<td>• Delete Sample area[a]: removes selected sample area from the Cineloop window and belonging trace in the Analysis window. The trackball marker must be pointed at an anchored sample area.
• Cancel: exits the System menu.</td>
</tr>
</table>

The Tissue cineloop window

	Displays 2D data **Sample area (1):** Indicates sampling position of the velocity (TVI), displacement (Tissue Tracking), percent deformation (Strain), deformation rate (Strain rate) or intensity (Contrast) trace. The sample area is color-coded: the first sample area is yellow, the second green...etc.
	Sample area tools: • : creates a sample area based on freehand drawing. • : creates a sample area with a pre-defined circular/elliptic shape (configurable, see page 217)

The analysis window



TVI:

Displays velocity trace

1. Y axis: velocity scale (cm/s)
2. X axis: Time (s)
3. ECG
4. Time at cursor position
5. Velocity at cursor position
6. Velocity at frame marker position (color coded)

Tissue Tracking

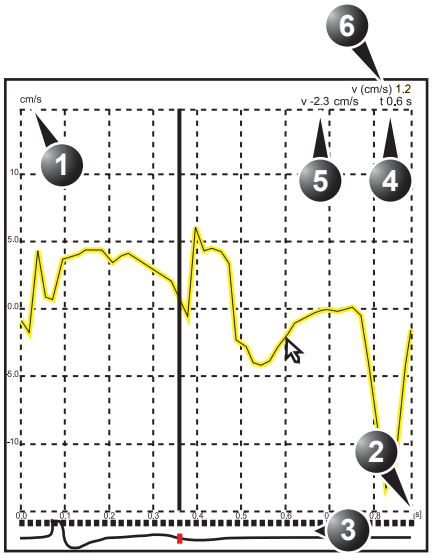
Displays tissue displacement trace

1. Y axis: displacement scale (mm)
2. X axis: time (s)
3. ECG with Tracking start and Tracking end markers
4. Time at cursor position
5. Displacement at cursor position
6. Displacement at frame marker position (color coded)

Strain rate

Displays Strain rate trace (rate of deformation (s^{-1}))

1. Y axis: s^{-1}
2. X axis: time (s)
3. ECG
4. Time at cursor position
5. Strain rate at cursor position
6. Strain rate at frame marker position



Strain:

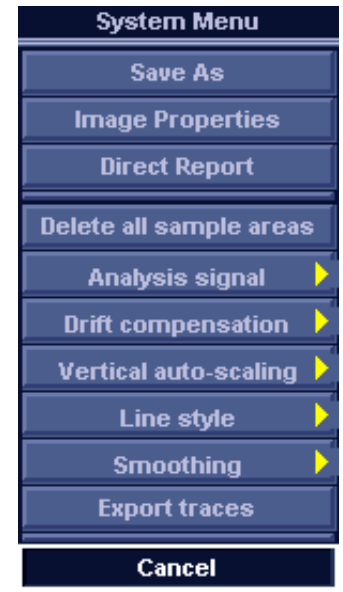
Displays Strain trace (extent of tissue deformation (%))

1. Y axis: percent displacement
2. X axis: time (s)
3. ECG with Strain start and Strain end markers
4. Time at cursor position
5. % deformation at cursor position
6. % deformation at frame marker position (color coded)

Contrast:

Displays time-intensity curve

1. Y axis: Intensity scale (logarithmic) (dB) or linear acoustic units (AU).
2. X axis: Time (s) or dT (s), elapsed time from previous frame.
3. ECG: displays ECG trace, the current frame marker and the start and stop markers for the cineloop.
4. Time at cursor position
5. Intensity (dB or AU) at cursor position
6. Intensity (dB or AU) at frame marker position (color coded)



a) With contrast data only.

b) Shown only in zoom mode.

The analysis window system menu:

This menu is entered by pressing the right mouse button when the mouse cursor is within one of the analysis window.

- **Delete all Sample areas**: removes all traces at once.
- **Analysis signal**: toggles trace display between velocity, displacement, strain rate, stain or greyscale intensity curves.
- **Drift compensation**: compensates drifting of strain or Tissue Tracking curves by either resetting the curve to zero at the tracking start point (cycle resetting) or by linear compensation throughout the cycle (linear compensation)
- **Horizontal scale**: set horizontal unit as time (s) or time interval (dt) between frames.
- **Vertical auto-scaling**: selects between full unit range or a range according to the maximum and minimum values of the displayed trace(s).
- **Vertical unit**[a]: toggles between logarithmic (dB) and linear acoustical units (AU).
- **Line style**: selects between solid line only or solid line with square markers at each data point.
- **Smoothing**: smooths the trace displayed by applying a filter over a defined time window. Both the filter type and time window are user-selectable. The type of filter available is depending on the analysis signal displayed.
- **Export traces**: saves trace data in ASCII format, readable in spreadsheet programs. If present, trace data for physiological traces are also exported.
- **Curve fitting**[a]: toggles between Wash-in, Wash-out and off.
- **Unzoom**[b]: restores full analysis window display when in zoom mode.
- **Cancel**: exits the *System menu*.

The control panel

The control panel is mode dependent. Refer to page 74 for control description.

Generation of a trace

Up to eight traces can be generated.

About the sample area

The sample area can be in three different states:

- **Free sample area**: freely moving sample area (QA cursor) before anchoring.
- **Static sample area**: the free sample area is anchored by pressing the left mouse button.
- **Dynamic anchored sample area**: the sample area is anchored in two or more frames (see Manual tracking below). In these particular frames, the sample area is displayed with an anchor. The sample area moves smoothly between the anchored positions when playing/scrolling the cineloop.

The free sample area disappears when the QA cursor is moved over a static anchored frame.

To generate a trace

Trace from a pre-defined sample area

The trace and sample area are color-coded. First generated trace is yellow, second green...etc.

1. If necessary, select the sample area **Shape button** .
2. Move the Mouse cursor to one of the *Cineloop windows*. The mouse cursor is changed to a sample area (white circle). A preview of the trace (in white) is displayed in the *Analysis window*.
3. Press the **Left mouse button** to anchor the sample area. In this frame the sample are is marked with an anchor. If the cineloop has more than one heart cycle a sample area will also be anchored in the corresponding frame in the next heart cycles. The trace is updated accordingly in the *Analysis window*.

The Strain cursor

In Strain and Strain rate modes, the sample area displays a Strain cursor showing the segment along the beam direction that is used for Strain and Strain rate calculations. Make sure that the Strain cursor is within the myocardium when anchoring the sample area.

Trace from a freehand sample area

1. Select the **Pencil button** .
2. Move the Mouse cursor to one of the *Cineloop windows*. The mouse cursor is changed to a cross.
3. Press and hold down the **Left mouse button** while drawing a sample area.
4. Release the **Left mouse button**.
   The sample area is automatically closed.
   The trace is updated accordingly in the *Analysis window*.

Manual tracking of the sample area (dynamic anchored sample area)

A sample area can be moved within the loop to ensure that data in the trace are generated from the same anatomical location during the cyclic motion of the heart.

1. Place a sample area over a region of interest.
   Note the anatomical location of the sample area.
2. Using the **Frame slider** (or **F3** and **F4** keys), scroll to a new frame.
3. Select the **sample area**.
   The sample area is unanchored.
4. Drag the **sample area** to the corresponding anatomical location in the new frame.
5. Press the **Left mouse button** to anchor the sample area to the location.

   When the sample area is anchored in more than one frame, linear interpolation is performed, so that the sample area is smoothly moved between the anchored positions in the selected frames when running the cineloop.

In the original frame and this particular frame the sample area is marked with an anchor.

6. Scroll through the cineloop and control that the sample area follows the moving anatomical structure.
7. Add anchored sample areas in several frames to obtain a more accurate displacement of the sample area.

To move a dynamic anchored sample area

In these frames the sample area is marked with an anchor.

1. Using the **Frame slider** (or **F3** and **F4** keys), browse through the cineloop to display one of the frames where the

sample area was anchored.

2. Select the **sample area** to move, in one of the *Cineloop windows*.
   The sample area is unanchored.
3. Drag the **sample area** to a new location.
4. Press the **Left mouse button** to anchor the sample area to the new location.

Zooming in the Analysis window

1. In the *Analysis window*, press and hold down the **Left mouse button** while dragging the **Mouse cursor** to define the zooming area.
2. Release the **Left mouse button**.
   The selected area is displayed in the *Analysis window*.

To unzoom

1. Press the **Right mouse button**.
   The *System menu* is displayed.
2. Select **Unzoom**.

Deletion of a trace

The user can delete all traces at once or one at a time.

To delete all traces

1. Press the **Right mouse button**.
   The *System menu* is displayed.
2. Select **Delete all traces**.

To delete one specific trace

1. Place the **Mouse cursor** on the sample area to delete.
2. Press the **Right mouse button**.
   The *System menu* is displayed.
3. Select **Delete trace**.

*Alternatively, press **Delete** or **Backspace**.*

Frame disabling

Frame disabling excludes the actual frame from the cineloop display. Frame disabling is available only with contrast data. There are two ways to disable a frame.

Disabling frames from the frame marker

1. Select the **Frame marker** beneath the *Analysis window* (see Figure 6-2).
   The frame marker turns red (disabled frame).

*To re-enable a frame: **select** the corresponding frame marker.*

disabling successive frames at a time

1. Press the **Left mouse button** and drag the **Mouse cursor** over the frame markers of the frames to disable.
   The frame markers turn red (disabled frames).

*To re-enable successive frames: **press the left mouse button** and drag over the frame markers.*

ECG triggered frame disabling

In a multi-cycle acquisition, the user may deselect all frames in all heart cycles but a selected one. This function can be used for example to select a particular systolic frame for each heart cycle.

1. Scroll through the cineloop to identify the cardiac phase to analyze or identify the cardiac phase on the ECG trace.
2. Press the **Right mouse button** on the frame marker of the frame of interest in one of the heart cycles (see Figure 6-2).

The *System menu* is displayed.

3. Select **ECG triggering**.
   All frames in all heart cycles are disabled except for the selected and corresponding frames in the other heart cycles.

Disabling frames in the cineloop windows

1. Press the **Right mouse button**.
   The *System menu* is displayed.
2. Select **Disable frame**.
   The current frame is disabled and the corresponding frame marker is displayed in red.

Re-enabling all frames

1. Press the **Right mouse button** over the *Frame marker axis*.
2. Select **Enable all frames**.

1. **Analysis window**
2. **Frame marker axis**
3. **Enabled frame (green marker)**
4. **Disabled frame (red marker)**
5. **ECG**
6. **Current frame**

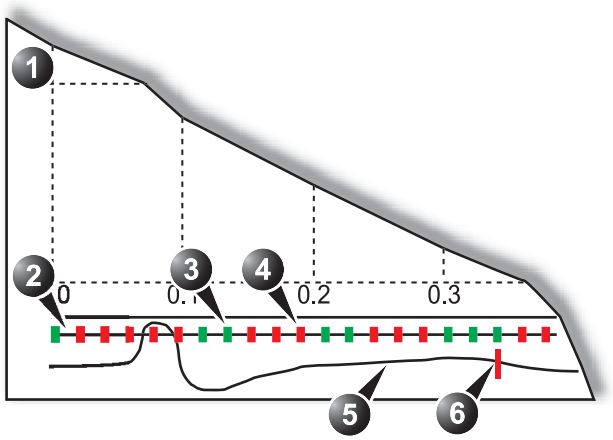


Figure 6-2: Frame disabling

Optimizing sample area

The sample area can be reshaped and labelled.

Reshaping a sample area

1. Place the **Mouse cursor** over the actual Sample area.
2. Press the **Right mouse button**.
   The *System menu* is displayed.
3. Select **Set Sample area shape**.
   A *Dialogue window* is displayed where the user can adjust the height, the width and the angle of the sample area (see Figure 6-3).

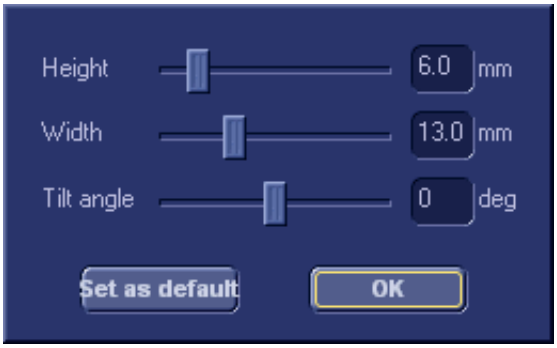


Figure 6-3: The sample area reshaping window

4. Drag the sliders to adjust the shape of the sample area as desired.
5. Press **OK** to return to the *Quantitative analysis screen* and use the settings for the current analysis only.
   OR
   Press **Set as default** to return to the *Quantitative analysis screen* and keep the settings as default.

Labelling a sample area

The sample area label is used to identify data associated to the sample area when exporting to a spreadsheet program.

1. Place the **Mouse cursor** over the actual **sample area**.
2. Press the **Right mouse button**.
   The *System menu* is displayed.
3. Select **Label Sample area...**.
   A *Dialogue window* with a free text field is displayed.

1. **Free text**

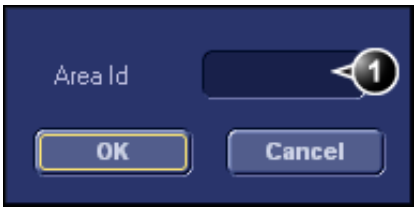


Figure 6-4: The sample area labelling window

4. Type a name for the **sample area**.
5. Press **OK** to return to the *Quantitative analysis screen*.

Optimizing the trace display

Optimizing the Y-axis

Auto-scaling

The system can be configured to display the full unit range or a range according to the maximum and minimum values of the displayed trace(s) (auto-scaling function). In addition, the auto-scaling function can be set to be live update (updates while the sample area is moved) or delayed (updated when the sample area is anchored).

Setting the auto-scaling function

1. Press the **Right mouse button** in the *Analysis window*. The *System menu* is displayed.
2. Select **Vertical auto-scaling**. The *Vertical autoscaling menu* is displayed.

Figure 6-5: The Vertical Auto-scaling menu

3. Select one of the following options:
   - **Delayed**: autoscaling takes place after anchoring the sample area.
   - **On**: autoscaling while moving the sample area.
   - **Off**: displays full scale.

Vertical units

Applicable with contrast data only.

When analyzing contrast data, the Y-axis can be set to display either logarithmic scale (dB) or linear, acoustical units (AU) for both tissue intensity (2D) or Angio intensity data.

Selecting the Y-axis unit

1. Press the **Right mouse button** in the *Analysis window*.
   The *System menu* is displayed.
2. Select **Vertical unit**.
   The *Vertical unit menu* is displayed.

Figure 6-6: The Vertical unit menu

3. Select the desired option.

Trace smoothing

The system can smooth the traces displayed by applying a filter over a defined time window. The type of filter available is depending on the analysis signal displayed.

Smoothing trace(s)

1. Press the **Right mouse button** in the *Analysis window*.
   The *System menu* is displayed.
2. Select **Smoothing**.
   The *Smoothing menu* is displayed.
3. Select a smoothing filter.
   The trace display is updated.

Switching modes or traces

The user can toggle between TVI, Tissue Tracking, Strain rate or Strain modes to access to the mode specific controls (soft menu and assignable) or display alternative traces from within a selected mode.

To switch mode

1. Select the desired mode (TVI, Tissue Tracking, Strain rate or Strain from the control panel.
   The *Color cineloop window* and the *Analysis window* are updated accordingly. The settings specific for the selected mode can be adjusted by pressing **Settings** in the *TVI modes field*.

To switch trace

1. Press the **Right mouse button** in the *Analysis window*.
   The *System menu* is displayed.
2. Select **Analysis signal**.
   The *Analysis signal menu* is displayed.

Figure 6-7: The Analysis signal menu

3. Select the desired trace.
   The Analysis window is updated with the selected trace.

Curve fitting analysis

Curve fitting analysis is used to estimate local myocardial perfusion rate using ultrasound contrast agents.

The analysis is based on two algorithms:

- **Wash-in curve fitting**: find and estimate local perfusion rate using contrast agent.

  Exponential wash-in is described by the function: *y(t)=A[1-e-kt]+B*, where:

  - **A** (dB or AU) is the intensity from the contrast agent.
  - **B** (dB or AU) is the intensity at time t = 0 (defined as the time of left marker). This corresponds to the tissue (baseline) signal if no contrast is present at the selected starting point.
  - **k** (1/s) is a time constant.

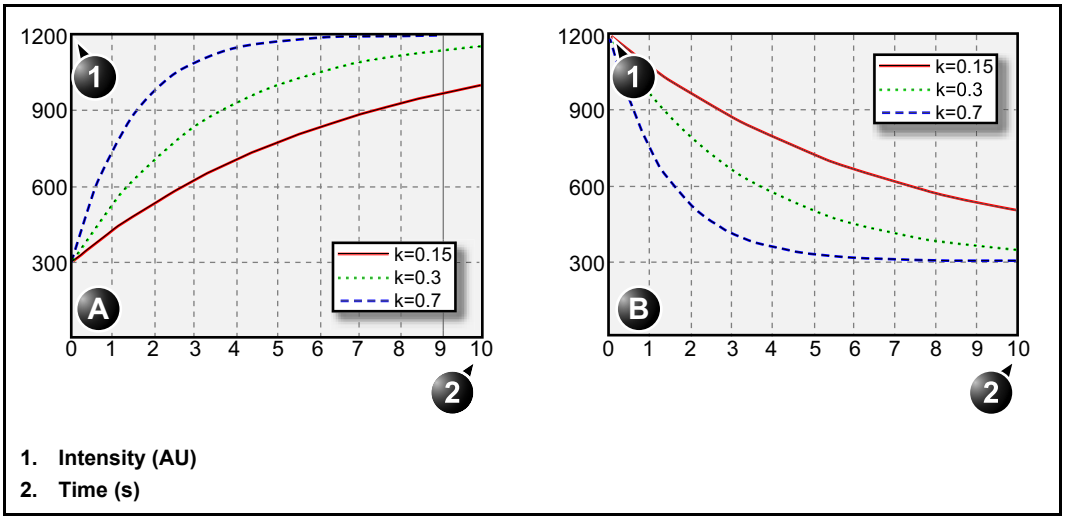
Note that A+B = contrast + tissue = plateau level.

- **Wash-out curve fitting**: find and estimate the wash-out rate of contrast agent locally (e.g. LV or myocardium). Exponential wash-out is described by the function:

  y(t)=Ae-kt+B, where:

  - **A** (dB or AU) is the intensity from the contrast agent.
  - **B** (dB or AU) is the intensity from the tissue = baseline signal.
  - **k** (1/s) is a time constant.

Note that A+B is the initial intensity level.



1. **Intensity (AU)**
2. **Time (s)**

Figure 6-8: :Curve fitting examples, A) wash-in, B) wash-out A=900 AU, B=300 AU for all curves

Wash-in curve fitting analysis

Overview

The purpose of wash-in curve fitting analysis is to find and estimate local perfusion rate using contrast agent. There are two methods to obtain this information:

- Use the Real-time CPI Contrast application with low transmit power (MI 0.1). Applying **Flash** will destroy most or all contrast within the imaging plane. The period of low power imaging immediately following the flash will contain the information on how fast contrast agent washes into different segments of the myocardium. By storing data 5 to 10 seconds after Flash and performing curve fitting to this data set, the user can explore myocardial perfusion.
- Use the myocardial Contrast application in triggered mode. This imaging mode is destructive for the contrast agent, and the interval between each frame determines the image intensity. Vary the triggering interval to obtain information regarding how fast the contrast agent washes into the myocardium after destruction.

Performing wash-in curve fit

From a contrast examination in Quantitative analysis:

1. Disable frames that are significantly different (i.e. because of respiration or probe movements), see page 215.

Up to eight different sample areas may be generated in the myocardium.

2. In one of the *Cineloop windows*, Anchor a **sample area** in the myocardium.
3. If desired, reshape the **sample area** as described on page 217.

Refer to page 213 for further details

4. Because of heart motion, the sample area in each frame has to be adjusted manually to be located inside the myocardium (Manual tracking of the sample area). The signals originating from the heart cavities are typically 10 to 20 times stronger than the signals from the myocardium, and will have a major effect on the averaging of signals in the sample area.
5. Using the **Frame slider** (or **F3** and **F4** keys), browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.

6. Use the **Horizontal sweep slider** and scroll through the cineloop to visualize a specific part of the data, typically the region immediately after Flash.
7. Adjust the **left** and **right markers** to apply curve fitting to a specific region.
8. Press the **Right mouse button** in the *Analysis window*.
   The *System menu* is displayed.
9. Select **Curve fitting**.
   The *Curve fitting menu* is displayed.

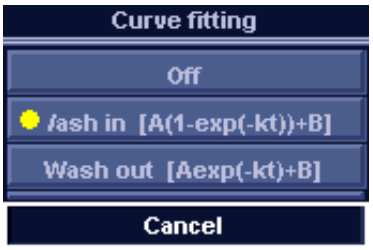
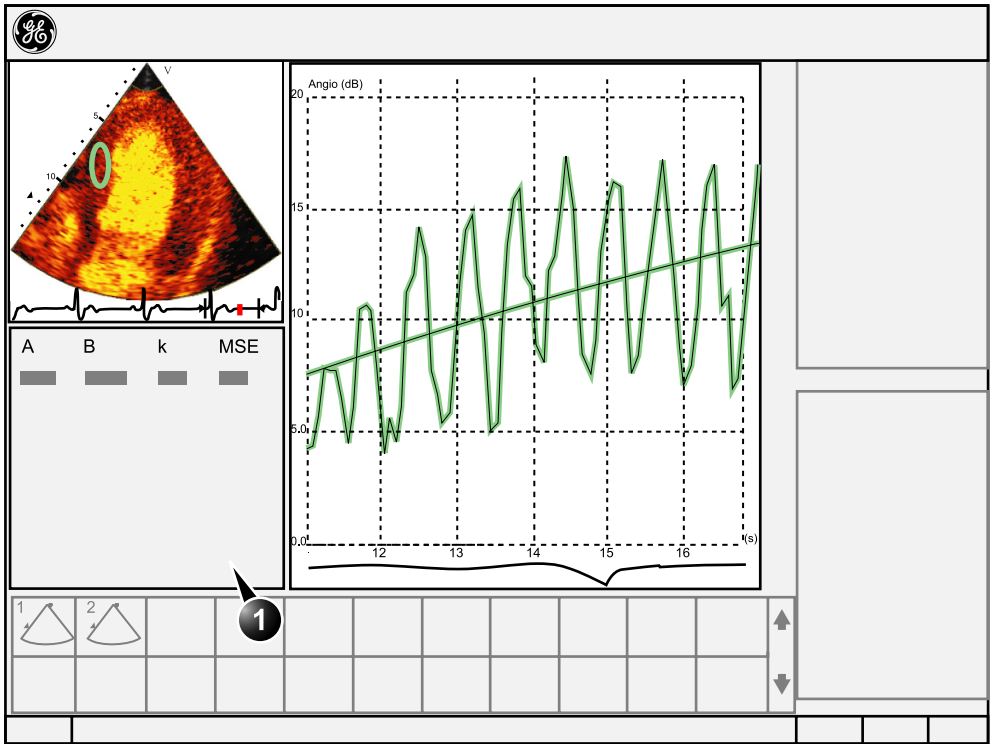


Figure 6-9: The Curve fitting menu

10. Select **Wash-in**.
    The Wash-in curve is displayed in the *Analysis window* (see Figure 6-10).



1. **Parameter window**

Figure 6-10: Wash-in curve fit of Real Time CPI data

Wash-in curve fitting using varying triggering intervals

If the data set contains frames with uneven time intervals, e.g. triggered images with increasing triggering intervals, it is possible to plot the data using the time interval (dt) on the X-axis.

1. Disable unwanted frames (see page 215). Curve fitting will be performed using all enabled frames.
2. In one of the *Cineloop windows*, Anchor one or more sample areas in the myocardium.

Up to eight different sample areas may be generated in the myocardium.

3. If desired, reshape the sample areas as described on page 217.

4. Perform **manual tracking** (see page 213) of the sample areas on all frames to ensure that the sample area is inside the myocardium.
5. Press the **Right mouse button** in the *Analysis window*.
   The *System menu* is displayed.
6. Select **Horizontal scale**.
   The *Horizontal scale menu* is displayed.
7. Select **dT scaling**.
   The X-axis in the *Analysis window* is updated accordingly.
8. Press again the **Right mouse button** in the *Analysis window*.
9. Select **Curve fitting**.
   The *Curve fitting menu* is displayed.

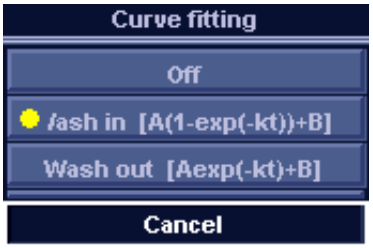
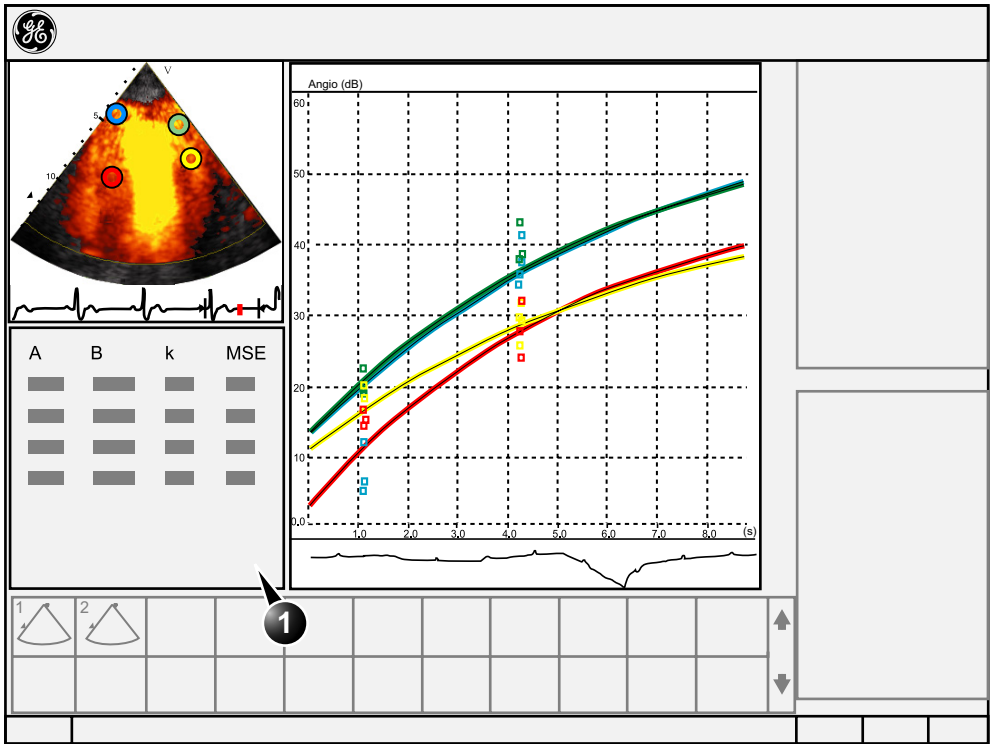


Figure 6-11: The Curve fitting menu

10. Select **Wash-in**.
    The Wash-in curve is displayed in the *Analysis window*.



1. **Parameter window**

Figure 6-12: Wash-in curve fitting after varying triggering interval

Wash-out curve fitting analysis

Overview

The purpose of wash-out curve fitting analysis is to find and estimate a local wash-out rate. The analysis may be used for wash-out of contrast from LV or myocardium.

Performing wash-out curve fitting

From a contrast examination in Quantitative analysis:

1. Disable frames that are significantly different (i.e. because of respiration or probe movements), see page 215.
2. In one of the *Cineloop windows*, Anchor a sample area in the myocardium.

Up to eight different sample areas may be generated in the myocardium.

3. If desired, reshape the sample area as described on page 217.
4. Because of heart motion, the sample area in each frame has to be adjusted manually to be located inside the myocardium (Manual tracking of the sample area). The signals originating from the heart cavities are typically 10 to 20 times stronger than the signals from the myocardium, and will have a major effect on the averaging of signals in the sample area.

Refer to 'Manual tracking of the sample area (dynamic anchored sample area)' on page 213 for further details.

5. Using the **Frame slider** (or **F3** and **F4** keys), browse through the cineloop to ensure that the sample area is in the same anatomical position in all frames.
6. Use the **Horizontal sweep slider** and scroll through the cineloop to visualize a specific part of the data,.
7. Adjust the **left** and **right markers** to apply curve fitting to a specific region.
8. Press the **Right mouse button** in the *Analysis window*. The *System menu* is displayed.
9. Select **Curve fitting**.
   The *Curve fitting menu* is displayed.

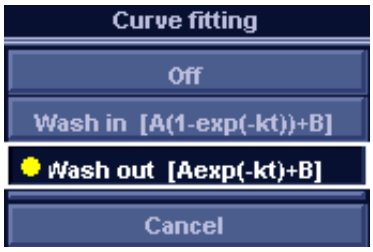


Figure 6-13: The Curve fitting menu

10. Select **Wash-out**.
    The Wash-out curve is displayed in the *Analysis window* (see Figure 6-14).

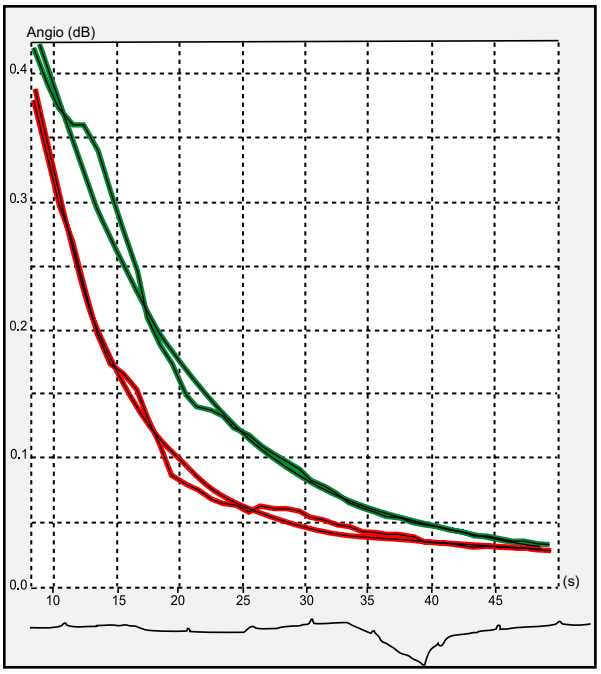


Figure 6-14: Wash-out curve fit of two sample regions in an in-vitro experiment

Anatomical M-Mode

Introduction

M-Mode applied to TVI, Tissue tracking, Strain rate, Strain or intensity data (Contrast) calculates and color/codes data accordingly along a path drawn by the operator.

Using Anatomical M-Mode

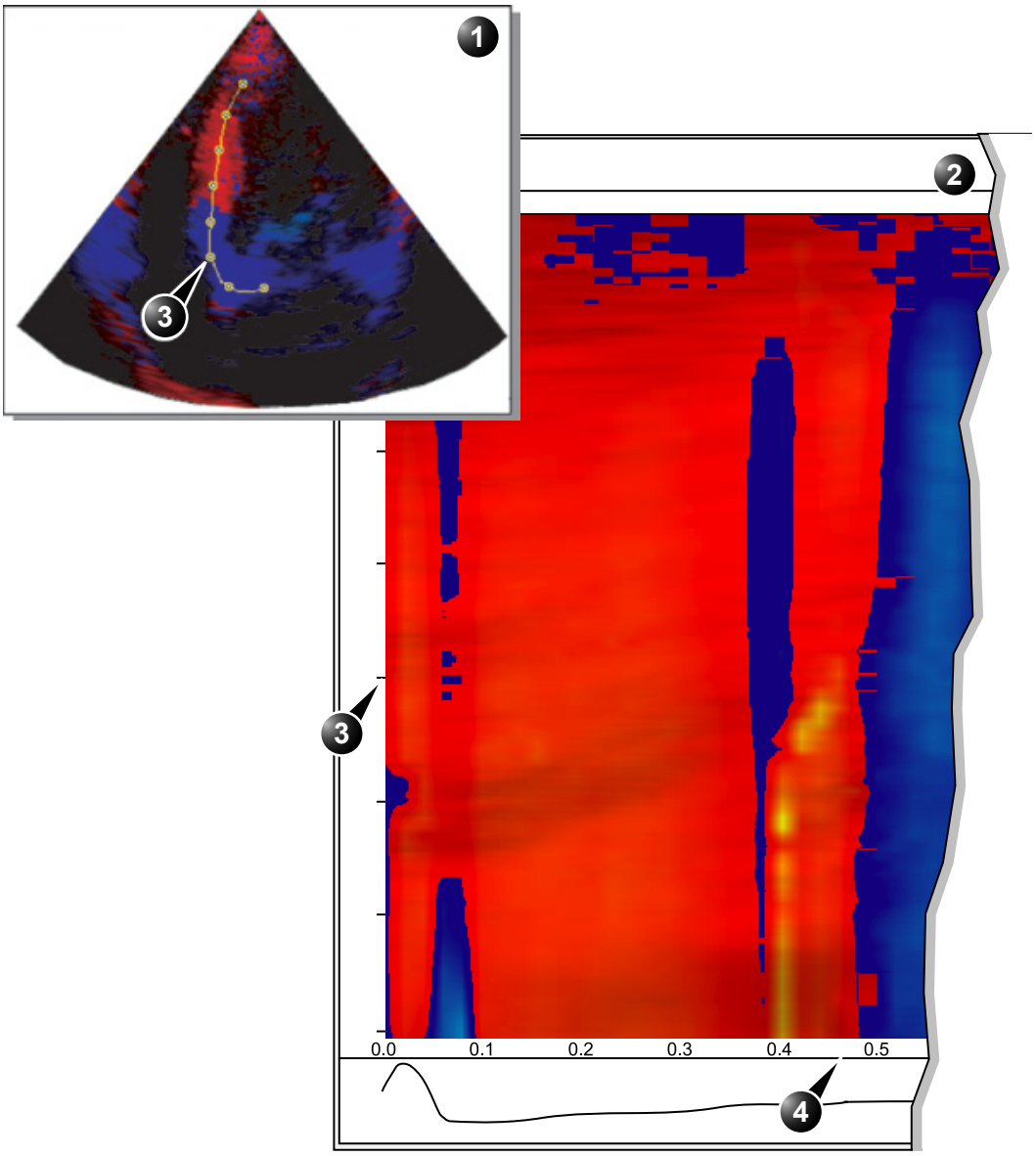
1. Select **CAMM** on the control panel.
2. In one of the *Cineloop windows*, anchor the first point of the path.
3. Move the **Mouse cursor** to the location for the next anchoring point of the path.

*To edit a path under construction, **follow the line backward** and retrace the path.*

4. Press the **Left mouse button** to anchor the second point. A path with two anchor points will give a straight anatomical M-Mode profile. By creating more than two anchor points, the user can bend the path and obtain a curved anatomical M-Mode profile.
5. Double click the **Left mouse button** to end the trace.

   The color-coded display of the corresponding data calculated along the path is shown in the *Analysis window* (see Figure 6-15).

*Adjust the **Horizontal sweep** and scroll through the cineloop to optimize the display to the portion of interest.*



1. **Cineloop window**
2. **Analysis window**
3. **Path anchor point**
4. **Time scale**

Figure 6-15: The anatomical M-Mode display (here TVI data)

Optimizing Anatomical M-Mode

Edition of the curve

The drawn Anatomical M-Mode path can be edited by moving the anchor points.

To move an anchor point

1. Select the anchor point to move.
2. Move the anchor point to a new position.
3. Press the **Left mouse button** to anchor the point to its new location.

Chapter 7
Worksheet

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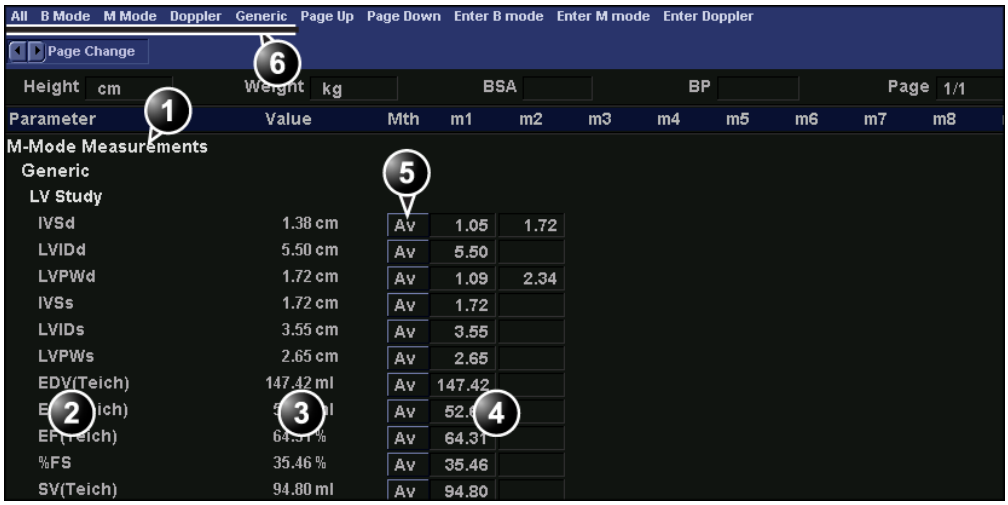
• Using Worksheet 238
- • To scroll through pages 238
- • To select the type of value 238
- • Excluding or including measurements 238
- • Manually changing a value 238
- • Deleting measurement parameter 239

Introduction

The worksheet function enables the user to review, edit, delete or print measurement data independently of a report. All measurements and calculations taken during the examination can be viewed at any time using the worksheet.

Overview



1. **Measurement type**
2. **Measurement parameter**
3. **Value: Averaging, Max, Min or Last**
4. **Measured / calculated values**
5. **Value type**
6. **Measurement type selection**

Figure 7-1: The Worksheet screen (Cardiac)

Using Worksheet

1. Press **Worksheet** and select the measurement type.

To scroll through pages

1. Press **Page up** or **Page down**.

To select the type of value

1. Select the relevant cell in the *Method column* (see Figure 7-2).
   A pop-up menu is displayed showing the different options available (Figure 7-2).
2. Select the required option.
   The value is updated accordingly

1. **Average of the measurements taken**
2. **Maximum measurement**
3. **Minimum measurement.**
4. **Last measurement that was taken**

Figure 7-2: The Calculation method options list.

Excluding or including measurements

One or more measurement values from a set of measurements for a parameter can be excluded when doing average calculation.

To exclude/include a measurement

1. Move the cursor over the measurement value to exclude/include.
2. Press the **Right mouse button** and select **Exclude value/Include value** in the displayed menu.

Manually changing a value

Individual measured values can be manually changed using the alphanumeric keyboard.

To manually change a value

*An asterisk indicates that the value has been manually altered. The calculation type is changed to **Edit**.*

1. Move the cursor over the value that is to be changed.
2. Press the **Left mouse button**.
3. Use the alphanumeric keyboard to enter the required value.

To restore automatic calculation

1. Move the cursor to the relevant cell in the *Method column*.
2. Press the **Left mouse button**.
   A pop-up menu is displayed showing the different calculation options available (Figure 7-2).
3. Select the required option.
   The value is updated accordingly

Deleting measurement parameter

1. Move the cursor over the value that is to be deleted.
2. Press the **Right mouse button** and select **Delete value** in the displayed menu.

Chapter 8
Report

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Introduction

The EchoPAC PC review station enables the creation of patient and examination reports containing measurements, images and analysis that were made during the examination. The layout of the reports id defined by generic templates delivered with the system. Custom templates can also be made.

Saved reports are *read-only*. Therefore it is recommended that the data is carefully reviewed before the report is saved. Use the worksheet (see page 235) to facilitate the review and adjustment of data before generating a report. The final report can be printed on a regular laser printer.

Creating a report

Reports summarize data obtained in the examination. They can contain data and images.

Once generated, the report can be viewed, images can be added, wall segment diagrams can be assigned and text can be entered in the free text fields. All other information must be changed from the *Patient information window* and the *Worksheet screen*.

Working with the report function

1. Select **Report**.
   The default template for the current examination is displayed. The information entered during the examination is automatically filled in (e.g. demographic, Diagnosis, Comments...etc.).

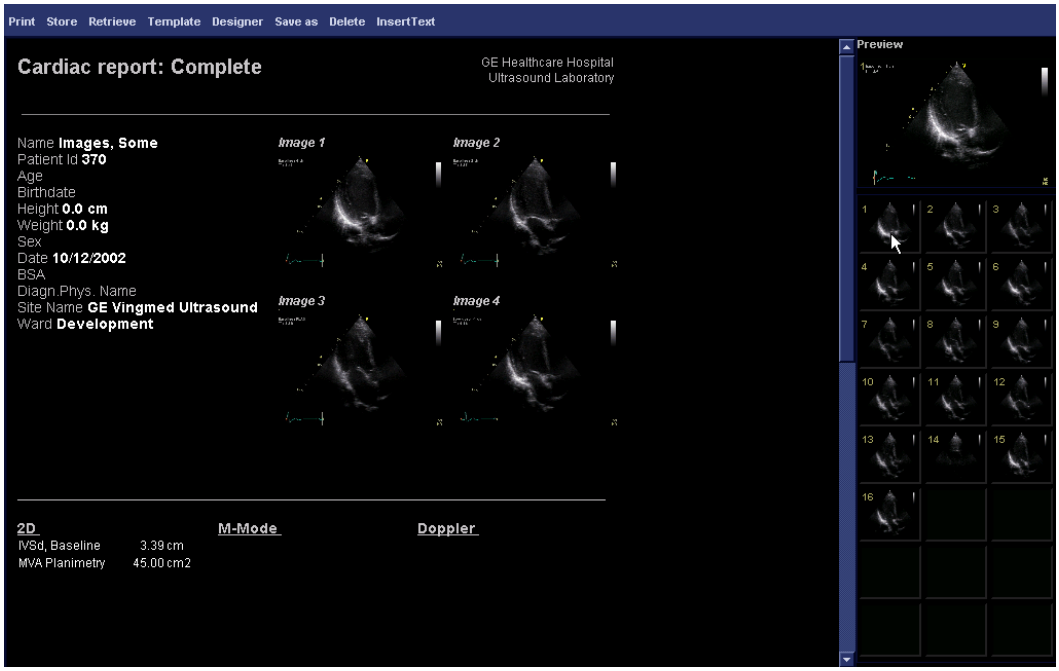


Figure 8-1: The Report screen

To choose another report template

1. Press **Template**.
   The *Template selection menu* is displayed showing the available report templates organized by application.
   Note: The *Template selection menu* can be configured to display only the templates of interest (see page 280).
2. Do one of the following:
   - Select a template from the current application template list.
   - Select another application and select the desired template from the sub-menu displayed.

     Note: From a sub-menu, select **Back** to return to the current application template list.

   The selected template is displayed on the screen.

To change patient information

1. Move the **Mouse cursor** over the heading of the information to change.
   The mouse cursor marker is changed to a hand with pointing finger.
2. Press the **Left mouse button**.
   The original location of the data is displayed.
3. Change the information entered if required.
4. Press **Report** when completed.

To add an image to the report

Images are inserted in the report by dragging a selected image from the clipboard into an *Image container* in the report.

1. Move the **mouse marker** over the image of interest.
2. Press and hold down the **Left mouse button** and drag the image in the *Image container* in the report.
3. To move an image between containers, press and hold down the **Left mouse button** and drag the selected image to the new location.
4. To remove an image from the report, press and hold down the **Left mouse button** and drag the selected image back to the clipboard.

To print a report

Only members of the user group “Cardiologist” are allowed to print a report (see page 335).

1. Press **Print**.
   The report is printed on the default printer. A status window is displayed showing the printing process.

To store a report

Only members of the user group “Cardiologist” are allowed to store a report (see page 335).

1. Press **Store**.
   The report is stored in the Report archive.
   A confirmation window is displayed when completed.
2. Press **OK**.

Alternative storage

Reports can also be saved in a user-defined location. The file format is Compiled HTML (.CHM), readable from any web browser or Portable Document Format (PDF), readable with Adobe Acrobat reader.

1. Press **Save as**.
   The *Save as dialogue window* is displayed.
2. Select the destination folder from the *Save in pull down menu*. The default location is the *Export folder*.
   The *Report archive folder* is selected by default.
   The default name for the report is of type:
   <exam DICOM UID>.
3. Enter a file name.
4. Press **Save**.

Retrieving an archived report

1. Press **Retrieve**.
   A list of the available reports for the actual examination is displayed.
   The default name for a report is of type:
   <template type>_<store date>_<store time>.
   To display the current report, select **Show active exam**.
2. Select the report to retrieve.

Deleting an archived report

Only members of the user group “Cardiologist” are allowed to delete a report (see page 335).

1. Press **Delete**.
   A list of the available reports for the actual examination is displayed.
   The default name for a report is of type:
   <template type>_<store date>_<store time>.
2. Select the report to delete.

Structured Findings

Structured Findings is a feature that enables the user to insert pre-configured structured diagnostic statements and codes (e.g Billing, Accreditation) in the patient report and create a conclusion based on the inserted statements.

Prerequisite

To be able to insert structured diagnostic statements and create a conclusion in a patient record, the report template used must have assigned fields for the structured findings, the codes and the conclusion.

To create the assigned fields in a report template:

1. Select **Report**.
2. Press **Template** and select the desired report template.
3. Select **Designer**.
   The *Report designer screen* is displayed.
4. Select the location in the report template where to insert the Structured findings fields.
5. Select **Insert** and **Archive Information**.
   The *Archive information box* is displayed (Figure 8-2).
6. Double-click on **Select All** under all three parameter fields in the *Archive information box* to deselect all parameters.
7. Select **Structured findings**, **Findings conclusion Indication codes** and **Billing codes** in the *Exam Information field* (Figure 8-2).
8. Select **OK**.
9. Save the Report template and exit the Report designer.

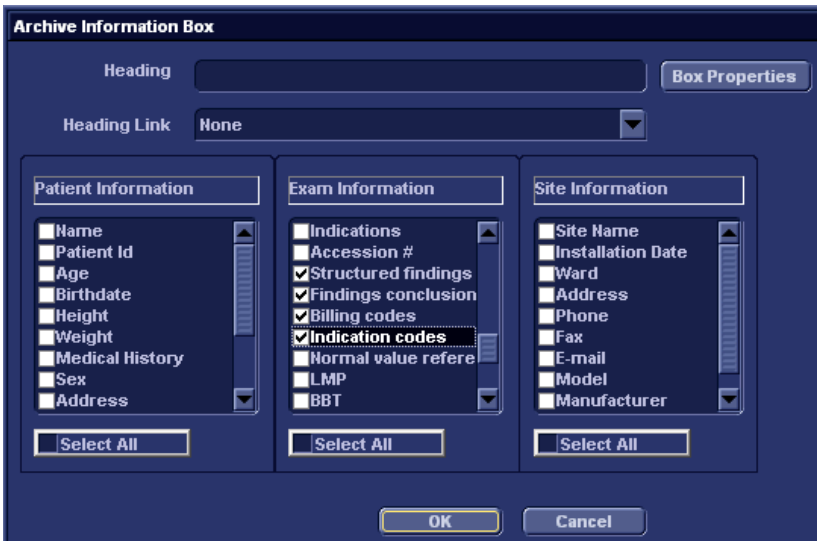


Figure 8-2: The Archive information box

Starting Structured Findings

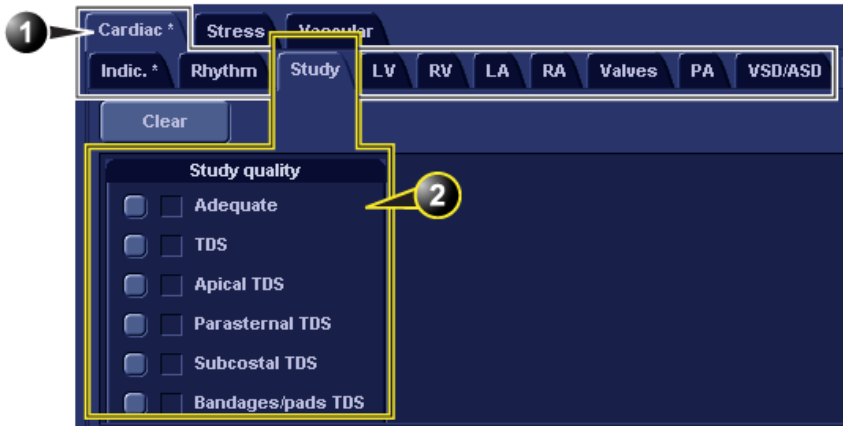
On EchoPAC PC, Structured Findings can be started from within the Report function or during Image Analysis.

1. Select **Report**.
   Make sure the current template has a Structured Findings field and a Conclusion field defined or select another template if necessary.
2. Select **Findings** in the report sub-menu.
   The *Structured Findings window* and a preview of the report are displayed.
   Note: from *Image Analysis screen* the button **Findings** is on the control panel. The *Structured Findings window* is displayed side by side with the images. A preview of the report is also displayed if the workstation has a dual screen.

Structured Findings structure

The diagnostic statements are organized in tab folders (see Figure 8-3). Each tab folder may contain:

- Underlying tab folders that contain Tab sheets.
- Tab sheets that contain diagnostic statements.

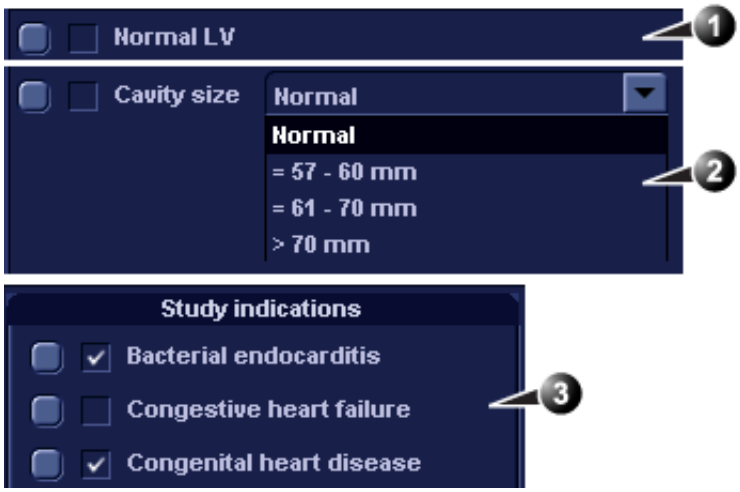


1. **Tab folder with underlying tab sheets**
2. **Tab sheet**

Figure 8-3: Structured findings structure

There are three types of diagnostic statements (see Figure 8-4):

- Check box statement: when selected the statement is included in the report.
- Combo box statement: create a statement by selecting one alternative text among several choices.
- Statement group: create several statements by selecting multiple check box statements.



1. **Check box statement**
2. **Combo box statement**
3. **Statement group**

Figure 8-4: Diagnostic statement types

Using Structured Findings

1. Start Structured Findings (see page 248).
2. Browse to the tab sheet containing the statements of interest.
3. To insert a statement in the report (Findings field):
   - Check box statement: select the statement.
   - Combo box statement: select an alternative text in the combo box next to the statement.
   - Statement group: select the statements of interest within the group.

   A preview of the selected statement(s) is displayed in the *Findings preview field* (see Figure 8-5). The statement text in the preview field can be edited. This will apply only for the current report.
   Once a statement is selected an asterisk is displayed on the tab of the current sheet and folder.
   Note: select **Normal** to select only normal statements from the current tab sheet (see page 257 for more information on how to define normal statements).

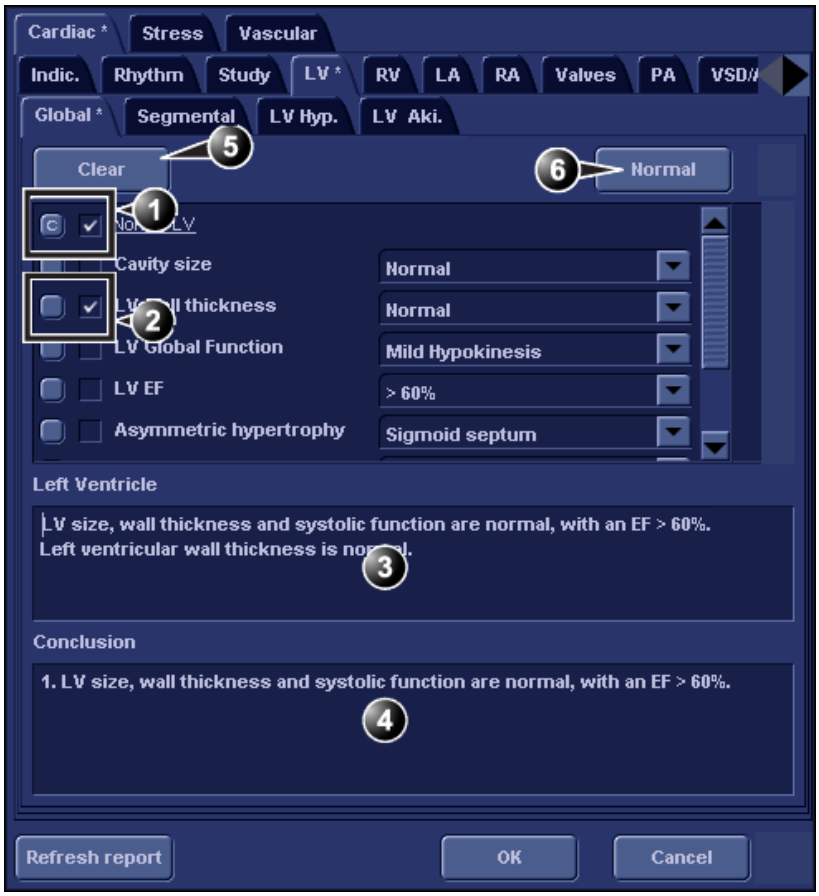
Note: select **Clear** to deselect all statements from the current tab sheet.

To insert a conclusion statement in the report:

- Press the Conclusion button in front of the statement of interest.

A preview of the selected conclusion statement is displayed in the *Conclusion preview field* (see Figure 8-5). Conclusion statements are displayed in a numbered list. The list can be reordered: triple-click on the conclusion statement to move in the *Conclusion preview field* and use the **ARROW UP** or **ARROW DOWN** key to move the statement up or down.
The conclusion text in the preview field can be edited. This will apply only for the current report.
To display the changes in the report, select **Refresh report**.
Note: pressing the Conclusion button in front of a statement that was not previously selected results in simultaneously inserting the finding statement and create the conclusion.

4. Press **OK**.
The report for the current patient is displayed with the selected findings, conclusion statement(s) and associated codes (if any).
Note: Some diagnostic statements have measurements values in the body text referred by a tag (e.g the {EF} tag refers to EF measurement). These statements require that the actual measurement is done to display correctly in the report.



1. **Statement inserted in the Conclusion and Findings field.**
2. **Statement inserted in the Findings field only.**
3. **Findings preview field**
4. **Conclusion preview field**
5. **Remove all selections.**
6. **Insert normal findings for the current tab sheet.**

Figure 8-5: Structured Findings window

Global selection of normal statements

It is possible to select all normal statements from all tab sheets.

1. Place the cursor in the *Statement field*, press the Right

mouse button and select **All normal**.
All statements defined as normal are selected from all the tab sheets. An asterisk is displayed on the tab of all the tab sheets that contain normal statements.
Note: this operation will remove any other “non-normal” previously selected statements.

2. To remove all statements at once, place the cursor in the *Statement field*, press the Right mouse button and select **Clear all**.

Structured Findings configuration

Structured Findings configuration is used to:

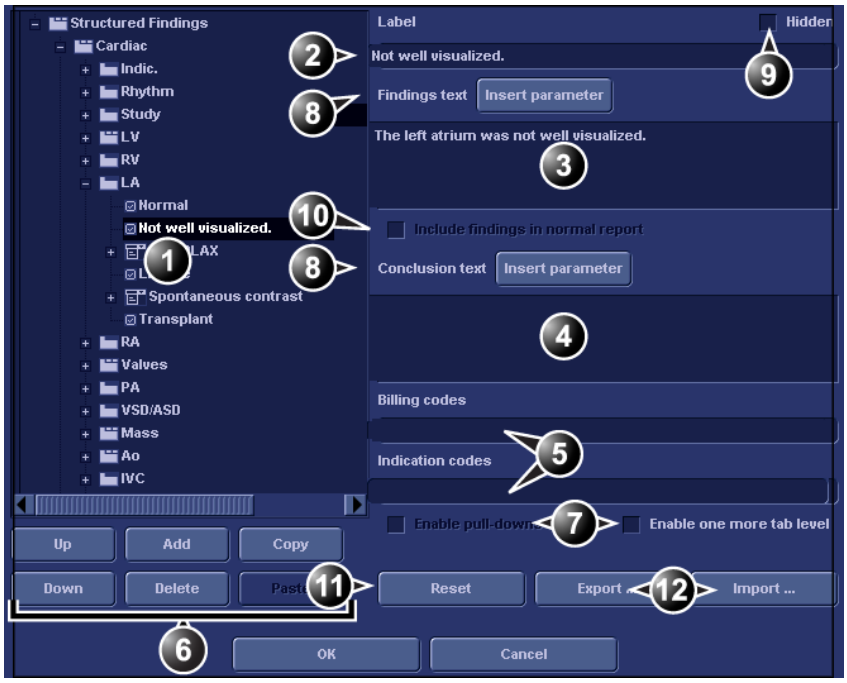
- Create, edit or delete finding statements, conclusion statements and codes.
- Organize the diagnostic statements in the *Structured Findings screen*.
- Define the normal diagnostic statements.

Accessing the Structured Findings configuration screen

1. Select **Config** (F2) and select the **Report** category.
2. Select the **Structured Findings** tab.
The *Structured Findings configuration screen* is displayed (Figure 8-6).

Or from within Structured Findings:

1. place the cursor in the *Statement field*, press the Right mouse button and select **Config**.

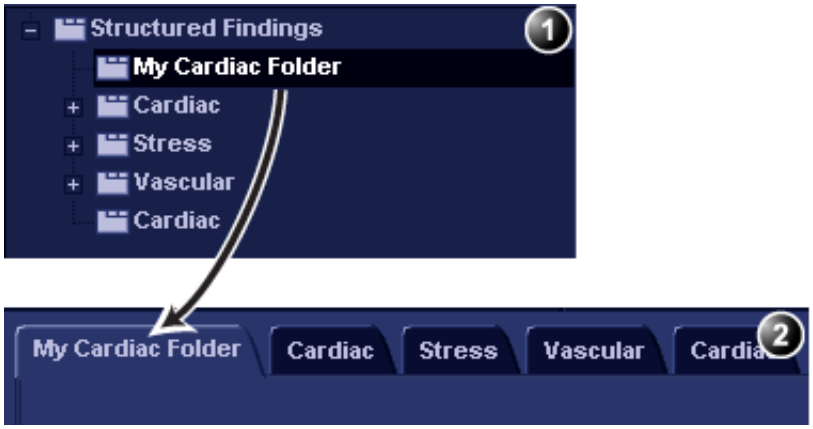


1. **Structured Findings structure tree:**
   - **tab folder**
   - **tab sheet**
   - **Check box statement**
   - **Combo box statement**
   - **Statement group**
2. **Tab or statement label**
3. **Findings text**
4. **Conclusion text**
5. **Codes for the selected statement**
6. **Create, move, copy or delete statement**
7. **Create folder, Combo box or statement groups**
8. **Enter a variable in statement or conclusion text**
9. **Hide selected tab or statement from the Structured Finding window**
10. **Set the selected statement as normal**
11. **Rest factory default findings**
12. **Export/import findings.**

Figure 8-6: Structured Findings configuration screen

Creation of a tab folder

The following procedure describes how to create a new top level tab folder.



1. **Configuration window**
2. **Structured findings window**

Figure 8-7: New tab folder

1. In the *Structured Findings configuration window* (Figure 8-6), select the Structured Findings tab folder.
2. Select **Add**.
   A new entry is created in the Structured Findings tab folder. The new entry is by default a tab sheet ( ).
3. Select **Enable one more tab level** to change the new entry to a tab folder ( ).
   A warning message is displayed. Select **OK**.
4. With the new entry selected, follow the following steps:
   - Enter a name in the *Label field* (tab name).
   - Enter a description in the *Findings text field*. The description will be displayed in the report as a heading when selecting a statement from the underlying tab sheets. The system is always using the Findings text from the highest item in the structure as a heading for the selected underlying statements.
   - Enter the appropriate codes.

Note: to enter several codes separate each code by a space.

5. Press **Up** or **Down** to move the tab in the structure tree (or do drag and drop).

Creation of a tab sheet

The following procedure described how to create a tab sheet in a tab folder.

1. **Configuration window**
2. **Structured findings window**

Figure 8-8: New tab sheet

1. Make sure that the tab folder is selected and press **Add**. A new entry is created in the tab folder. The new entry is by default a tab sheet ( ).
2. With the new entry selected, follow the following steps:
   - Enter a name in the *Label field* (tab name).
   - Enter a description in the *Findings text field*.

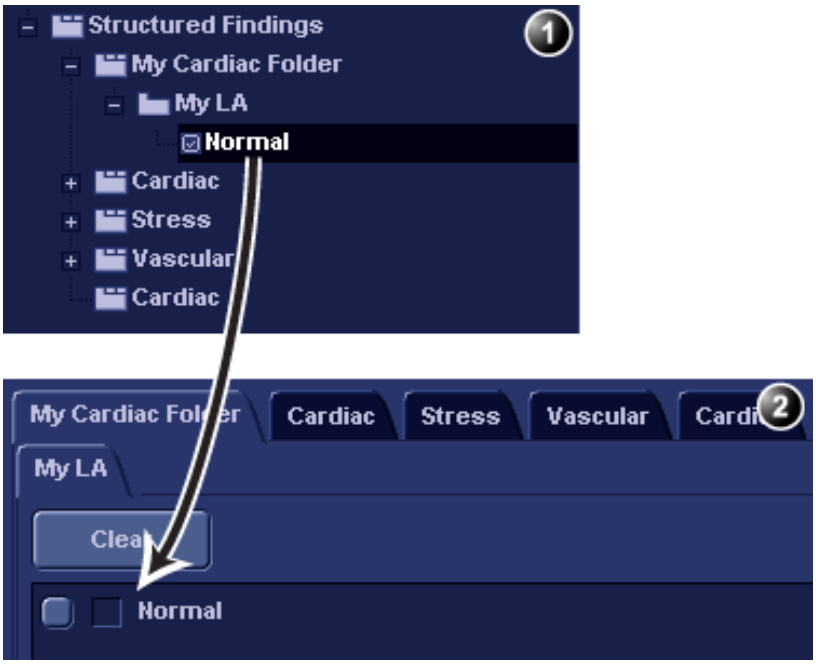
   If required:
   - Enter the appropriate codes.

     Note: to enter several codes separate each code by a space.

Adding statements in the tab sheet

Check box statement

The following procedure describes how to create a check box statement.



1. **Configuration window**
2. **Structured findings window**

Figure 8-9: New check box statement

1. Make sure that the tab sheet is selected and press **Add**. A new entry is created in the tab sheet. The new entry is by default a check box statement (☑).
2. With the new entry selected, follow the following steps:
   - Enter a name in the *Label field* (statement name).
   - Enter the full statement in the *Findings text field*.
   - Enter a conclusion in the *Conclusion text field* (optional).

     Note: if the *Conclusion text field* is left empty, the statement text will be used as conclusion when selected.

If required:

- Enter the appropriate codes.

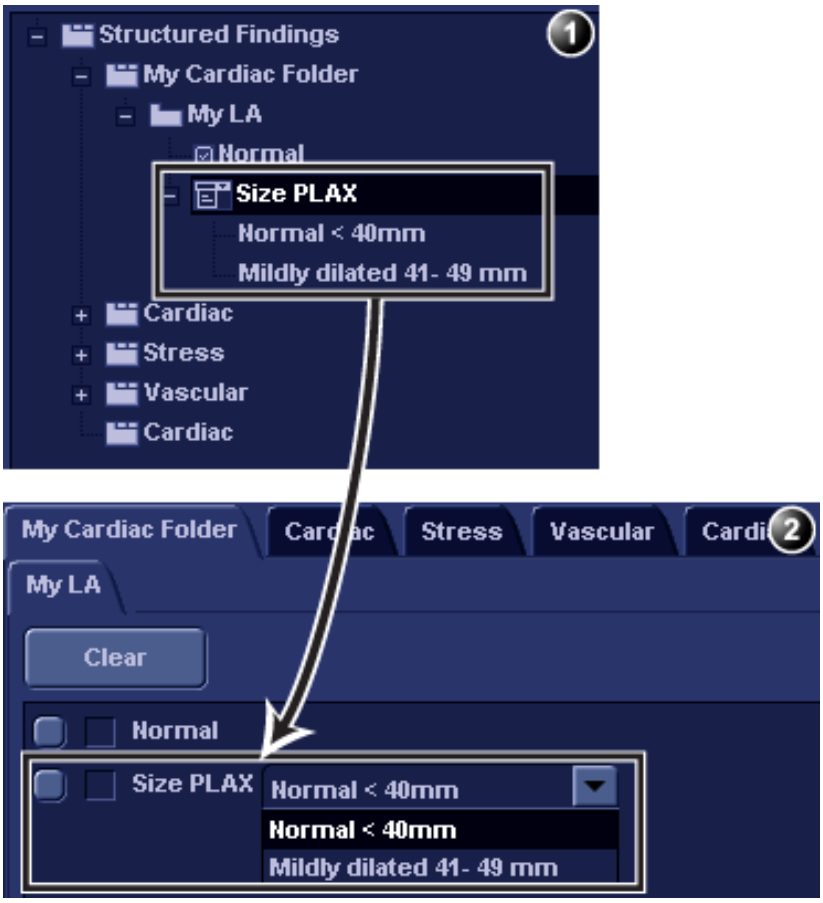
  Note: to enter several codes separate each code by a space.

- Check **Include findings in normal report** to define the statement as normal.

  All statements within the selected tab sheet that have this option checked will be included in the report when **Normal** is selected in the *Structured Findings window* (see ’Using Structured Findings’ on page 250).

Combo box statement

The following procedure describes how to create a combo box statement.



1. **Configuration window**
2. **Structured findings window**

Figure 8-10: New combo box statement

1. Create a new statement as described above. A check box statement is created by default.
2. With the new statement selected, press **Add**.
   A new underlying entry is created and the parent statement is changed to a Combo box statement ( ).
3. With the new underlying entry selected, follow the following steps:
   - Enter a name in the *Label field*.
   - Enter a text in the *Findings text field*.

- Enter a conclusion in the *Conclusion text field* (optional).

4. Repeat the procedure from step 2 to create as many underlying statements as necessary. Each underlying statement will be a selectable entry in the combo box.

Statement group

Statement groups are created by changing a combo statement to a statement group.

1. Create a combo box statement as described above.
2. Make sure the combo box statement is selected and deselect the option **Enable pull-downs**.
   The combo box statement is changed to a statement group ( ). Each underlaying entries are changed to check box statements.

Editing a statement

Tab label, statements and statement alternative texts can be edited.

1. In the *Structured Findings configuration window* (Figure 8-6), select the item to edit.
2. Make the required changes.

Inserting variable parameters in a statement

Variable parameters such as patient name, institution name, measurement values...etc can be inserted in a statement as tagged information.

To insert variable parameters in a statement:

1. Place the cursor at the required position in the *Findings text field* (or *Conclusion text field*).
2. Press **Insert parameter**.
   The *Insert parameter window* is displayed (see Figure 8-11).
3. Browse and select the actual parameter to insert.
   Note: for measurement values, select first the scanning mode.
4. Press **OK**.
   The selected parameter is inserted in the statement as a tag (e.g the {EF} tag refers to EF measurement)

Note: to display correctly in the report, the actual parameter value must exist, e.g. if a measurement value is included in a statement as a variable parameter, a measurement value must exist for the current patient, otherwise the parameter name is displayed.

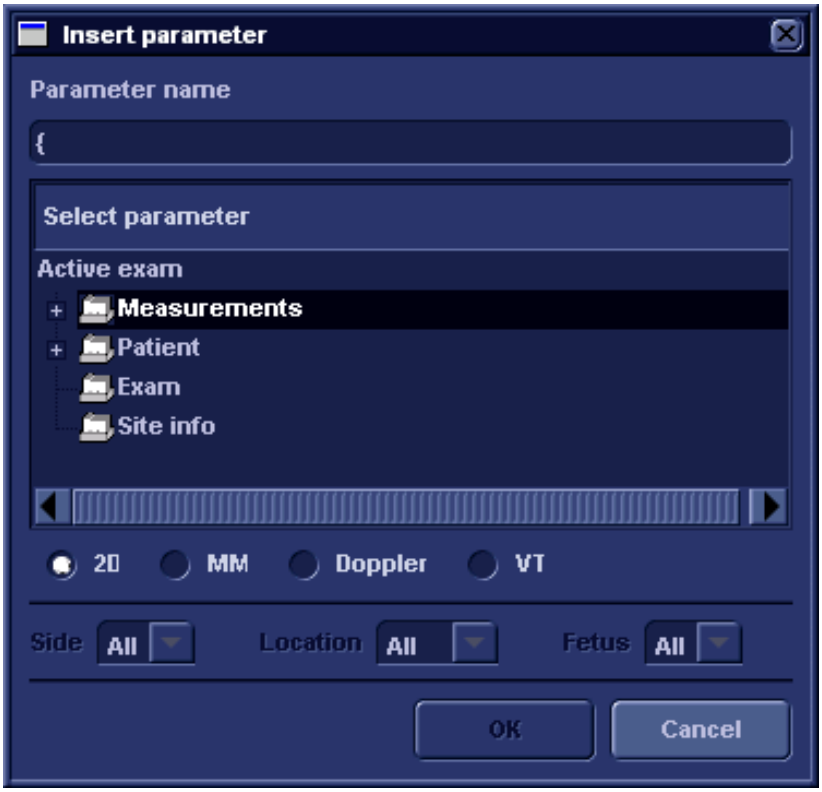


Figure 8-11: Insert parameter window

Copy of a statement

Tab folders, tab sheets and statements can be copied from one location to another. The word “Copied” is added to the copied item name.

1. In the *Structured Findings configuration window* (Figure 8-6), select the item to copy.
2. Select **Copy**.
3. Select the item to contain the copy.
4. Select **Paste**.

Note: if the item to copy cannot be copied in the selected location, the operation is ignored.
Note: copy can be done by drag-and-drop, while holding **CTRL** depressed.

Deletion of a statement

Tab folders, tab sheets and statements can be deleted.

△
CAUTION

Deletion cannot be undone.

1. In the *Structured Findings configuration window* (Figure 8-6), select the item to delete.
2. Select **Delete**.
   The selected item is deleted.

Factory reset

All statements can be reset back to the factory default.

△
CAUTION

Factory reset cannot be undone.

1. Select **Reset**.
   The *Reset statements window* is displayed.
2. Select:
   - **Yes** to reset all statement to the factory default (No undo).
   - **No** to cancel the operation.

Exporting/Importing statements

Diagnostic statements can be exported from one system and imported on another system.

Exporting statements

1. In the *Structured Findings configuration window* (Figure 8-6), select **Export**.
   A browsing window is displayed.
2. Browse to a destination and select **Save**.

Importing statements

CAUTION

Importing statements will replace the current statements. If necessary, backup the current statements by exporting them before performing import.

1. In the *Structured Findings configuration window* (Figure 8-6), select **Import**.
   A browsing window is displayed.
2. Browse to a destination and select **Open**.

Report designer

The Report designer software package enables the user to create report templates that best suit its needs.

Designing a report template consists of choosing the information to display in the report (e.g. header, footer, logo, patient information, images, measurements...etc.) and arrange it in the report viewer.

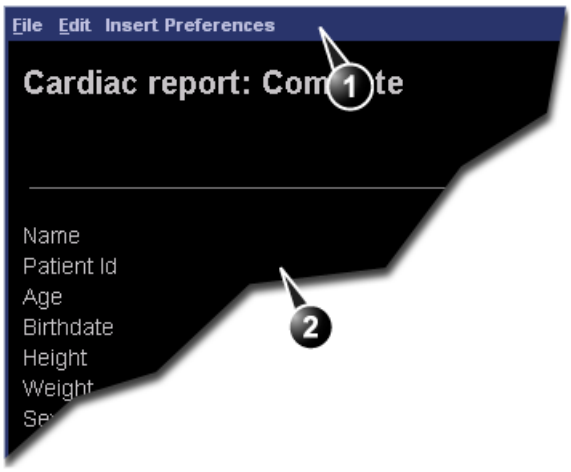
The Report designer function is based on the information container concept: each type of information is included within a container with parameters that can be configured (size, color, font properties, information to display...etc.).

Accessing the Report designer

1. Press **Report**.
2. Press **DESIGNER**.
   The *Report designer screen* is displayed with the selected template in the *Report template design area* (see Figure 8-12).

Report designer overview

The Report designer screen



1. **Menu bar**
2. **Report template design area**

Figure 8-12: The Report designer screen

The menu bar

Menu	Description
File	• **New**: start working on an new template. • **Save**: save the template using the same name. Factory report templates cannot be overwritten. • **Save as**: save the template using a new name. • **Page setup**: define printing orientation and header/footer for the printed report. • **Print Preview**: display a print preview of the report template. • **Exit**: exit the Report designer and returns to the report function. The user can choose whether to save the updates or restore the original template.

Menu	Description
Edit	• **Delete**: remove the selected object from the report template. • **Undo**: restore the previous state of the report template.

Menu	Description
Insert	• **Page Break**: insert a new page in the report template. • **Table**: configure and insert a table in the report template. • **Logo**: select and insert a logo to the report template. • **Archive info**: select and insert data from the following categories: Patient information Exam information Site information • **Anatomical graphics**: select and insert an anatomical graphic (cardiac, vascular or TEE). • **Image**: create a container for the display of ultrasound images. • **Wall motion analysis**: insert a container for the display of Stress Echo analysis results (cut planes Bull's eye and scoring table). • **OB/GYN**: insert OB graph. • **Measurements**: insert a container for the display of measurements and calculations. When creating a measurement container, the user is prompted through a configuration procedure enabling the selection of mode specific measurements and/or calculations. • **Text field**: insert a container where the user can write in the report. • **Fixed text**: insert a container with static text. The text typed during the creation of the container will be displayed in the report.

Menu	Description
Preferences	• **Page Color**: sets the default background color for the template page.

Designing a report template

Starting template designing

1. Start the Report designer (see page 264).
2. Press **File** and select **New** to display a blank page or use the current report template as basis template.

Setting the layout preferences

Adjusting the report page color background

1. Press **Customize** and select **Page Color**.
   The *Color selection window* is displayed.
2. Select the desired color.
3. Press **OK**.

Header and footer in the printed report

This function is described on page 277.

Inserting an information container in the report template body

The different type of information to be included in a report are grouped in information containers. Designing a report template consists in inserting and configuring the different information containers in the template page in an ordered manner.

Information containers can be inserted either:

- Directly into the report template body: this procedure does not allow side-by-side insertion, the information container will normally cover the width of the report template page.
- Within a table: this procedure allows side-by-side insertion of several information containers.

Inserting a table

1. Press the **Left mouse button** at the desired insertion point in the *Report template design area*.
2. Press **Insert** and select **Table**.
   The *Container properties window* is displayed (see Figure 8-13).
3. Adjust the parameters as desired.
4. Press **OK**.
   The table is displayed in the template.

Note: To modify an inserted table, double-click in an empty area in the table. A selection menu is displayed where the user can add, delete a row or a column or open the *Table properties window*.

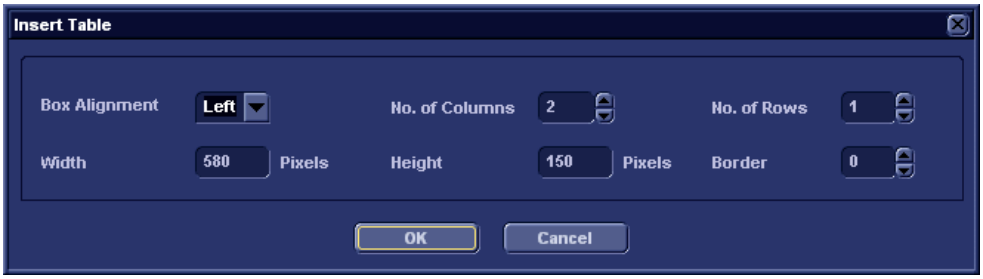


Figure 8-13: The Table properties window

Inserting a logo

1. Provide the hospital logo in JPEG or Bitmap format onto a CD or MO disk.
2. Select the location where to insert the logo (a table cell or directly in the report template).
3. Select **Insert** and **Logo**.
   The *Logo box* is displayed.

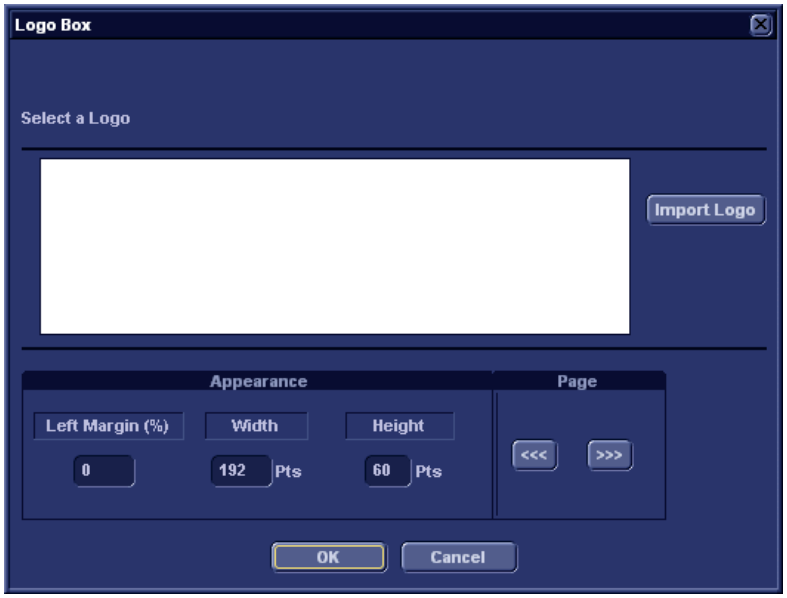


Figure 8-14: The logo box

4. Select a logo, or if not available, select **Import logo**. Browse and select the logo and select **OK**.
5. Specify the appearance.
6. Select **OK**.

Inserting fixed text

Fixed text is an entry that cannot be changed in the report (e.g. hospital information).

1. Select the location where to insert the fixed text (a table cell or directly in the report template).
2. Select **Insert** and **Fixed text**.
   The *Fixed text box* is displayed.

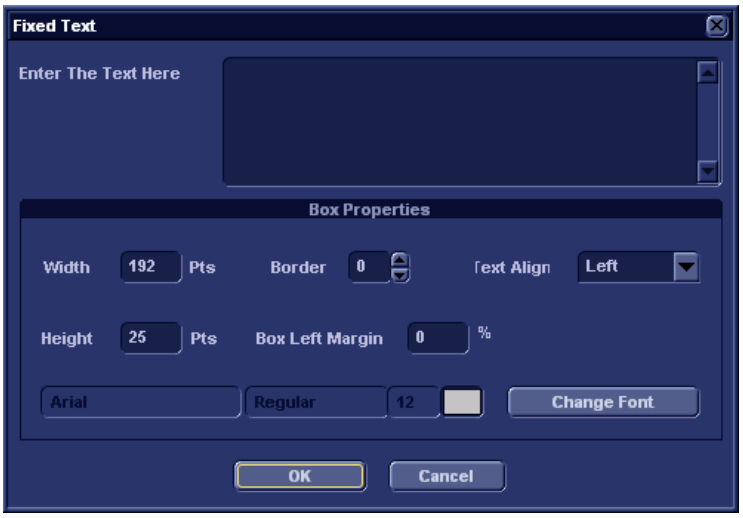


Figure 8-15: The Fixed text box

3. Enter the text and specify the appearance.
4. Select **OK**.

Inserting archive information

Archive information contains all the objects of the different information menus (Patient, Exam, Study and Site Information).

You may display the archive information over two columns using a table container as described below.

1. Insert a table for the archive information to the desired location (a table cell or directly in the report template).
2. Select the first table cell.

3. Select **Insert** and **Archive information**.
   The *Archive information box* is displayed.

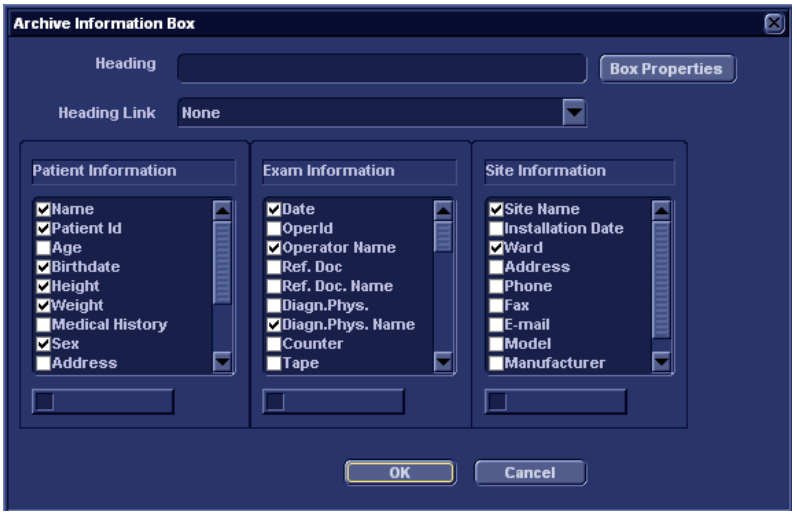


Figure 8-16: The Archive information box

4. If desired, enter a heading and select a heading link from the pull-down menu.
5. Select the Information parameters to be displayed in the first cell.
   Select **Box properties** to change the font, alignment, appearance, etc.
6. Select **OK**.
7. Select the next table cell and repeat steps 3 to 6 to enter the remaining archive information.

Inserting an Image container

- Select the location where to insert the fixed text (a table cell or directly in the report template).
- Select **Insert** and **Image**.
  The *Ultrasound image box* is displayed.

Figure 8-17: The Ultrasound image box

- If desired, enter a heading, set the container size and specify the text appearance.
- Select **OK**.

Inserting measurement containers

You may display the measurements over several columns using a table container as described below.

1. Insert a table for the measurements to the desired location.
2. Select the first table cell.
3. Select **Insert** and **Measurements**.
   The *Measurements box* is displayed.

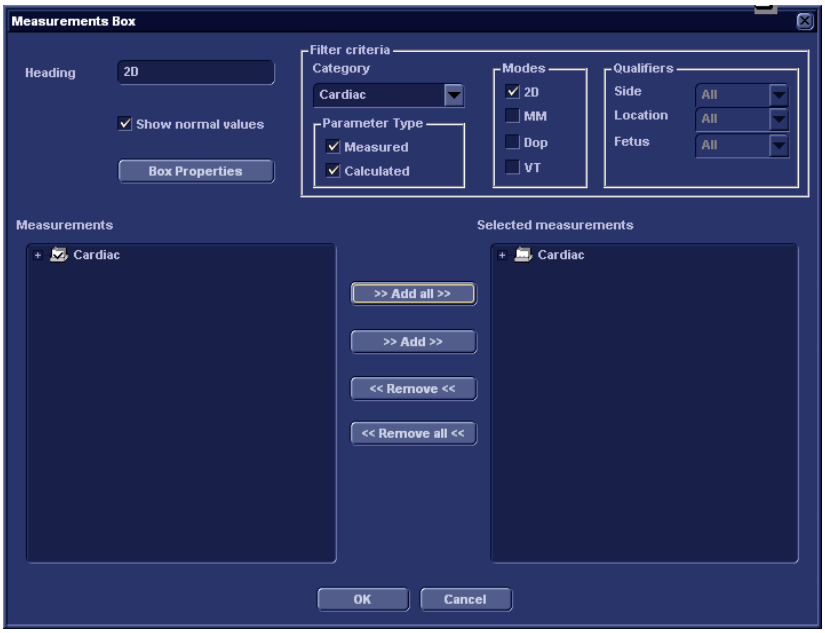


Figure 8-18: The Measurements box

4. Enter a heading (e.g. 2D).
5. Using the *Filter criteria*, define the type of measurements to be displayed (e.g. Cardiac, 2D, measured and calculated). Select **Show normal value** to display user-defined Normal value next to the measurements in the Report (see 'Normal values' on page 164 for more information).
   Note: References for the normal values can be displayed in the report by checking **Normal value references** from **Insert** -> **Archive Info** (see page 270).
   The *Measurement list* on the left side is updated.
6. From the measurement list, select the measurement to insert and press **Add**. Both single measurements or a folder may be added.
7. The list of the inserted measurements is displayed in the *Selected measurement list* on the right side.
8. Press **OK**.
9. Select the next table cell and repeat steps 3 to 8 to insert several measurements.

Inserting Text fields

Text fields are:

- Containers for Referral reasons, Comments and Diagnosis information.
- Containers for free text, where the user can type information in the report.

1. Select the location where to insert the text field container (a table cell or directly in the report template).
2. Select **Insert** and **Text field**.
   The *Text field box* is displayed.

Figure 8-19: The Text field box

3. Enter a heading.
4. From the *Display field*, select between:
   - **Referral reasons**: displays the information entered in the Direct report (see page 90) or in the *Examination list window*.
   - **Comments**: displays the information entered in the Direct report (see page 90) or in the *Examination list window*.
   - **Diagnosis**: displays the information entered in the

Direct report (see page 90) or in the *Examination list window*.

- **Free text 1-8**: creates an empty free text container.

5. If desired, adjust the font settings for the header and data.

Inserting Wall motion scoring analysis containers

Two different containers must be inserted for the Wall motion scoring analysis:

- A Wall motion scoring diagrams container (Cut planes or Bull's eyes)
- A Wall motion scoring table

Inserting Wall motion scoring diagrams container

1. Select the location where to insert the free text container (a table cell or directly in the report template).
2. Select **Insert**, **Wall motion analysis** and select between **Cut planes** and **Bull's eye**.
   The corresponding *Wall motion scoring box* is displayed.

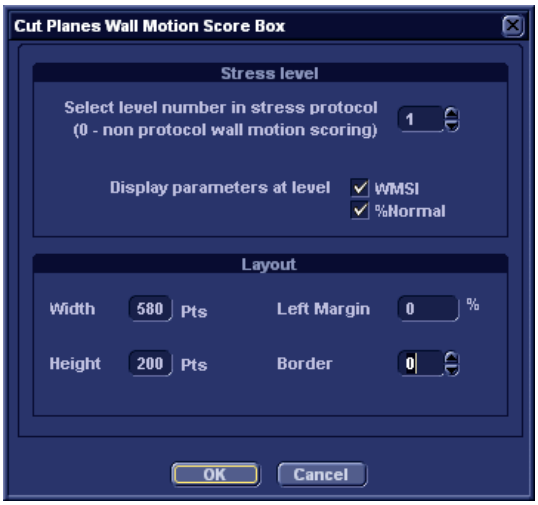


Figure 8-20: The Wall motion scoring box (Cut planes)

3. Adjust the parameters and select **OK**:
   The scoring diagrams are inserted in the report template

Inserting Wall motion scoring table container

1. Place the cursor right below the *Wall motion scoring*

diagrams container.

2. Select **Insert**, **Wall motion analysis** and select **Score table box**.
   The *Score table box* is displayed.

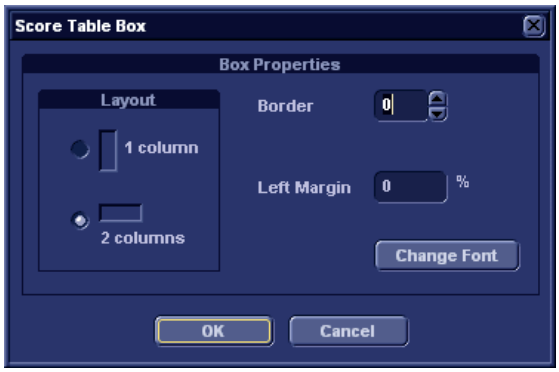


Figure 8-21: The Score table box

3. Adjust the layout parameters in the *Score table box* and select **OK**.
   The *Score table* is inserted in the report template.

Editing the information container

Resizing the information container

1. Move the **Mouse cursor** over the border of the container to resize.
   The mouse cursor is changed to a cross ✣.
2. Press **Left mouse button** once.
   The container is displayed with anchor squares on the sides and at the corners.
3. Resize the container by dragging from the anchor points.

Editing the information container properties

Modifying the container's specific properties

1. Move the **Mouse cursor** over the border of the container to edit.
   The mouse cursor is changed to a cross ✣.
2. Double-click on the **Left mouse button**.
   The *Container box* is displayed.
3. Adjust the parameters specific to the selected container.

Note: Some information containers have additional parameters that may be adjusted by selecting **Box properties**.

Inserting a new page

1. In the template, position the Mouse cursor at the insertion point.
2. Press the **Left mouse button**.
3. Press **Insert** and select **Page Break**.

Inserting header and footer

Header and footer may be defined to be displayed in the printed report. The header and footer are not visible in the on screen report.

To insert header and footer in the printed report:

1. Select **File** and **Page setup**.
   The Page setup box is displayed.

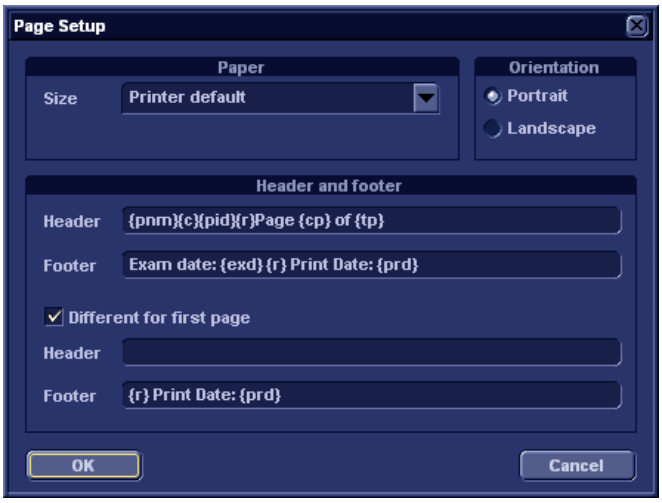


Figure 8-22: The Page setup box

2. Adjust the printing orientation.
3. Define the header and footer for the printed report, by typing text and entering the required variables listed in the table below.
   Check **Different on first page** and create a specific header/footer for the first page.
4. Select **OK**.

To check the display of the header and footer, select **File** and **Print preview**.

Variable	Description
{pid}	Patient ID
{pnm}	Patient name
{pdb}	Patient date of birth
{exd}	Examination date
{prd}	Current date (printing date)
{prt}	Current time (printing time)
{cp}	Current page
{tp}	Page count
{c}	Subsequent entries are centered
{r}	Subsequent entries are right aligned

Saving the report template

Replace an existing template

Factory templates cannot be overwritten.

1. Press **File** and select **Save**.
   A dialogue window is displayed asking for confirmation.
2. Select:
   - **Yes** to save the report template
   - **No** to discard the report template
   - **Cancel** to go back to the Report designer without saving the report template.

Save existing template with a new name

1. Press **File** and select **Save as**.
   The *Save as template window* is displayed.

Figure 8-23: The Save as template window

2. Enter a name for the template.
3. Press **OK**.
   The template is saved.

To exit the Report designer

1. Select **File** and **Exit**.
   The *Exit window* is displayed.
2. In the Exit window, select:
   - **Yes**: to save the report template and exit the application.
   - **No**: to exit the application without saving the changes made in the report template.
   - **Cancel**: to return to the application.

Report templates management

This section describes:

- Configuration of the *Template selection menu*.
- Deletion of user-defined report templates.
- Export/import of user-defined report templates.

The report templates management is done from the *Report templates sheet* in the system configuration package.

To access to the *Report templates sheet*:

1. Press **CONFIG** (**F2**) and select the **Report** category.
   The *Report category sheet* is displayed.

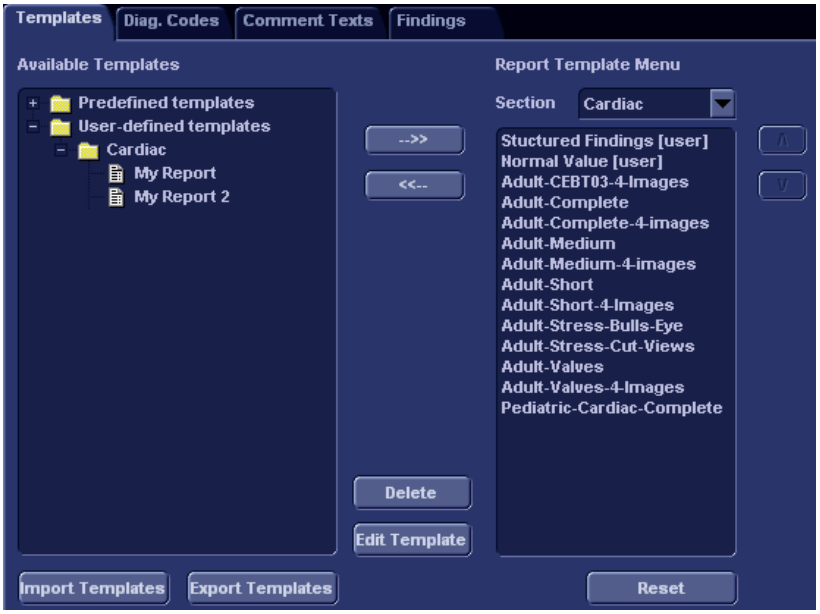


Figure 8-24: The Report template sheet

Configuration of the Template selection menu

The *Template selection menu* displays the application specific report templates that can be selected when creating a report. The *Template selection menu* can be configured to display only the templates of interest.

Inserting a template in the Templates selection menu

1. Press CONFIG (F2) and select **Report**.
   The Report template sheet is displayed (Figure 8-24)
2. In the *Available templates field* (left field), select the template to insert in the *Template selection menu*.
3. Next to *Section*, select the appropriate application.
4. Press the **Right arrow button** [->>].
   The selected template is inserted in the *Template selection menu*.
   Note: Double-clicking on a template in the *Available template field* will also insert the template in the *Template menu*.

Removing a template from the Template selection menu

1. In the *Report template menu field* (right field), select the template to remove.
2. Press the **Left arrow button** [<<-].
   The selected template is removed from the *Template selection menu*.
   Note: Double-clicking on a template in the *Report template menu field* will also remove the template from the *Template menu*.

Sorting the templates in the Template selection menu

1. In the *Report template menu field*, select the template to move.
2. Press the **Up** or **Down arrow buttons** [^] [v].
   The selected template is moved accordingly in the Template selection menu.

Deleting a report template from the system

Only user-defined report templates can be deleted from the system.

1. In the *Available templates field* (left field), select the report to delete (Figure 8-24).
2. Press **Delete**.

A Confirmation window is displayed.

3. Select **Yes** to delete the report template.

Export/Import of Report templates

User-defined report templates can be exported to a removable media and imported from the removable media into another system (EchoPAC PC/EchoPAC PC).

Export of Report templates

1. Insert a removable media in the in the drive.
2. Press **CONFIG** (**F2**) and select **Report**.
   The Report template sheet is displayed (Figure 8-24, page 280).
3. Select **Export Templates**.
   The available user-defined templates are displayed in the *Export templates window*.

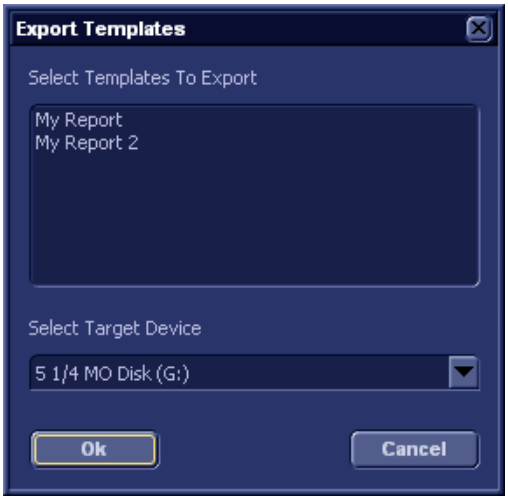


Figure 8-25: The Export templates window

4. Select the templates(s) to export. Multiple selection can be done using **SHIFT** or **CTR** key.
5. Select the desired removable media under *Select target device*.
6. Press **OK**.
   A Confirmation window is displayed.

7. Press **OK**.
   The selected template(s) are exported to the removable media.
8. Press **ALT** + **E** and select the media to eject.

Import of Report templates

1. Insert the removable media with the report template(s) to import.
2. Press **CONFIG** (**F2**) and select **Report**.
   The Report template sheet is displayed (Figure 8-24, page 280).
3. Select **Import Templates**.
   The *Import template window* is displayed.

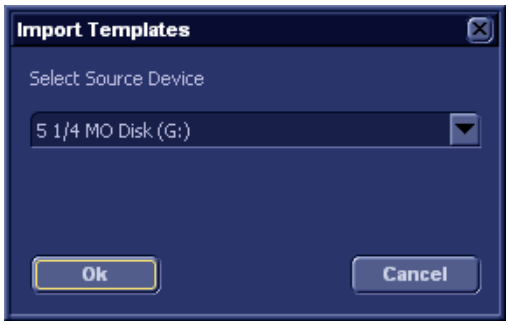


Figure 8-26: The Import template window

4. Select the source device from the pull-down menu.
5. Press **OK**.
   A Confirmation window is displayed.
6. Press **OK**.
   The templates are imported into the system.
7. Press **ALT** + **E** and select the media to eject.

Chapter 9
Program configuration

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Introduction

This chapter describes the configuration management package of EchoPAC PC workstation. The EchoPAC PC configuration package enables the user to customize the global configuration for the workstation.

In addition, users with administration rights have access to the local archive backup function, local archive restore function and creation of users.

The configuration management package consists of a *Setup dialogue window* divided in different setup categories with sublevels.

The table below summarizes the contents and access rights of the different categories and sublevels of the EchoPAC PC configuration package:

Category and sublevel	Description	access	Refer to
Imaging			page 291
• Global	Sets the cineloop controls and display. Sets the patient information display.	All	
Measure/Text			page 293
• Measurement menu • Advanced • Modify calculations	Configures the *Measurement menu* by selecting and defining the sequence of the measurements and calculation to perform. Creates user-defined measurements Configures vascular Doppler calculations to be performed.	All	
• OB table	Create user-defined OB tables.	All	
• Annotation • Customize	Configures the Annotation menu and create pre-defined annotation.	All	
Report			page 307

Category and sublevel	Description	access	Refer to
• Templates	Configures the *Report templates menu* by selecting and ordering the templates to show in the menu.	All	
• Diagnostic codes	Create or delete pre-defined text input for the referral reasons and diagnosis.	All	
• Comment texts	Create or delete pre-defined text input for the comments.	All	
Connectivity			page 311
• Dataflow	Create new dataflows or configure existing dataflows.	Admin	
• Additional outputs	Configure the **Alt. Store 1** and **Alt. Store 2** keys.	Admin	
• Tools	Formats removable media.	All	
• Formats	Configures the *Examination list window display* and other options related to the patient management.	All	
• TCPIP	Sets the Transmission Protocol/Internet Protocol.	All	
System			page 328
• Settings	Sets the date and time format, language and units.	Admin	
About	Displays information about the software.	All	page 333
Administration			page 334
• Backup	Local archive and system configuration backup.	Admin	
• Restore	Restore local archive and system configuration from a backup.	Admin	

Category and sublevel	Description	access	Refer to
• Users	Operator and referring staff registration, operator's rights settings.	Admin	
• Unlock patient	Unlock patient records that were not properly finished.	Admin	

Starting the Configuration package

To access the Configuration package the user has to log on as a specific user (see page 335). This ensures user-specific and user-defined settings and presets to be used.

The access to the entire configuration package is user configuration dependent (see page 335).

To open the Configuration package

1. Select **config**.
   The *Log In window* is displayed asking for operator ID and password (see Figure 9-1).
2. Select **Log on** when completed.
   The *Setup dialogue window* is displayed (see Figure 9-2).

1. **Select the operator**
2. **Type password**

Figure 9-1: The Operator login window

Overview

The configuration management package consists of a *Setup dialogue window* divided in different setup categories with sublevels (sheets labelled with tab).

The functionality of each configuration category and associated sublevels are described on the following pages.

1. **Sublevel tabs for the selected Setup category.**
2. **Setup categories**
3. **Selected Setup category**

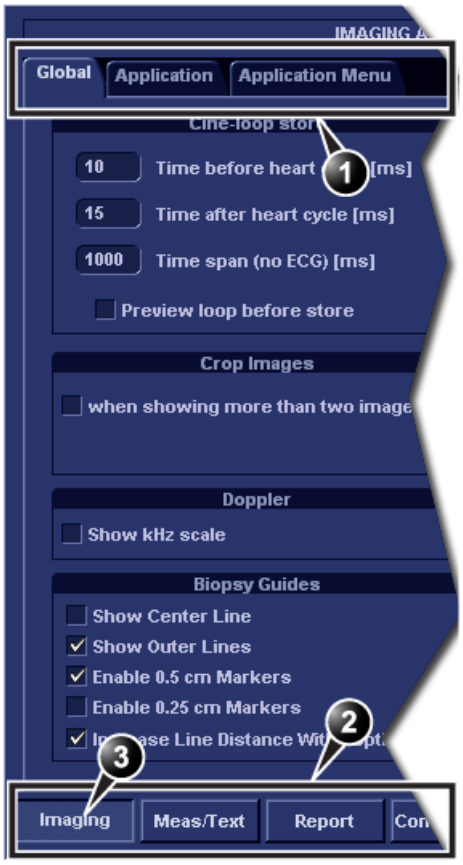


Figure 9-2: The Setup dialogue window structure

Imaging

The *Imaging configuration category* enables the user to configure display-related settings.

The Global setup sheet

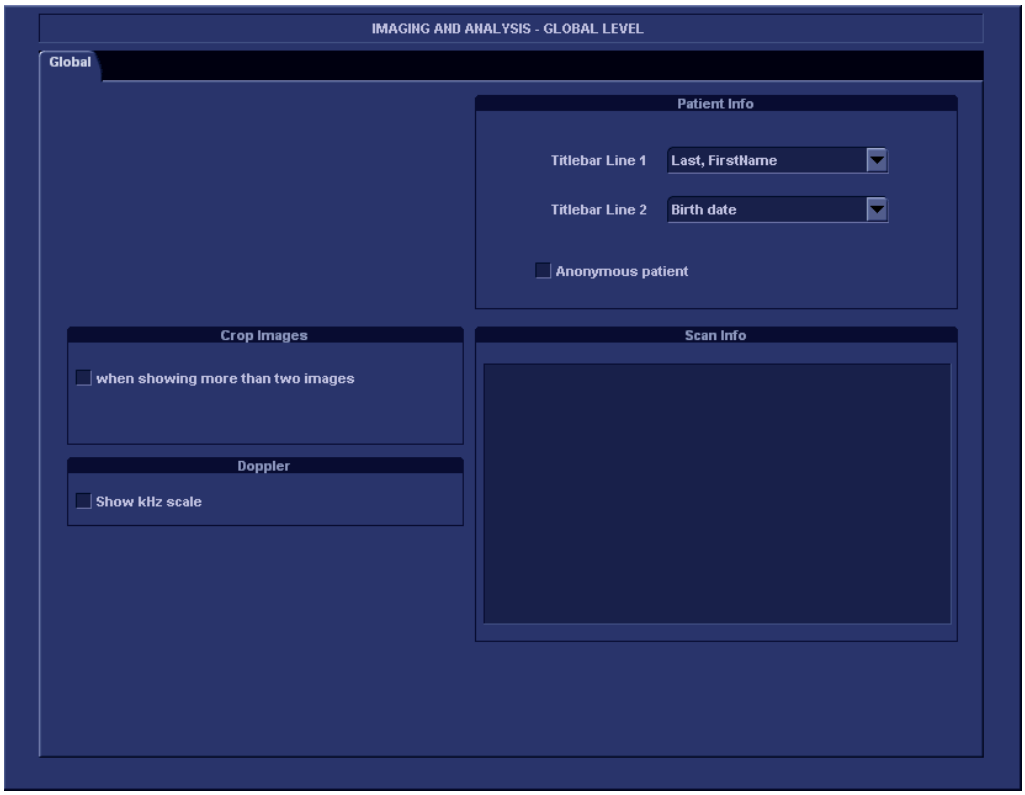


Figure 9-3: The Global setup sheet

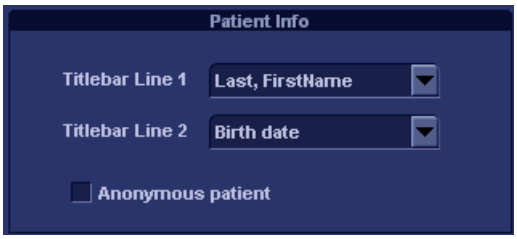
Crop images

Parameter	Description
	Crop images: ☑: In the *Analysis screen*, removes top and bottom of the image when more than two images have been selected.

Doppler

Parameter	Description
	Doppler: • Show KHz scale: when selected, displays the KHz scale on the left side of the Doppler spectrum.

Patient Info

Parameter	Description
	**Patient Info:** • **Title bar Line1 & 2**: selects from the pop-up menu the patient information to display on the *Title bar.* • **Anonymous patient**: when checked, no patient information is displayed on the *Title bar*.

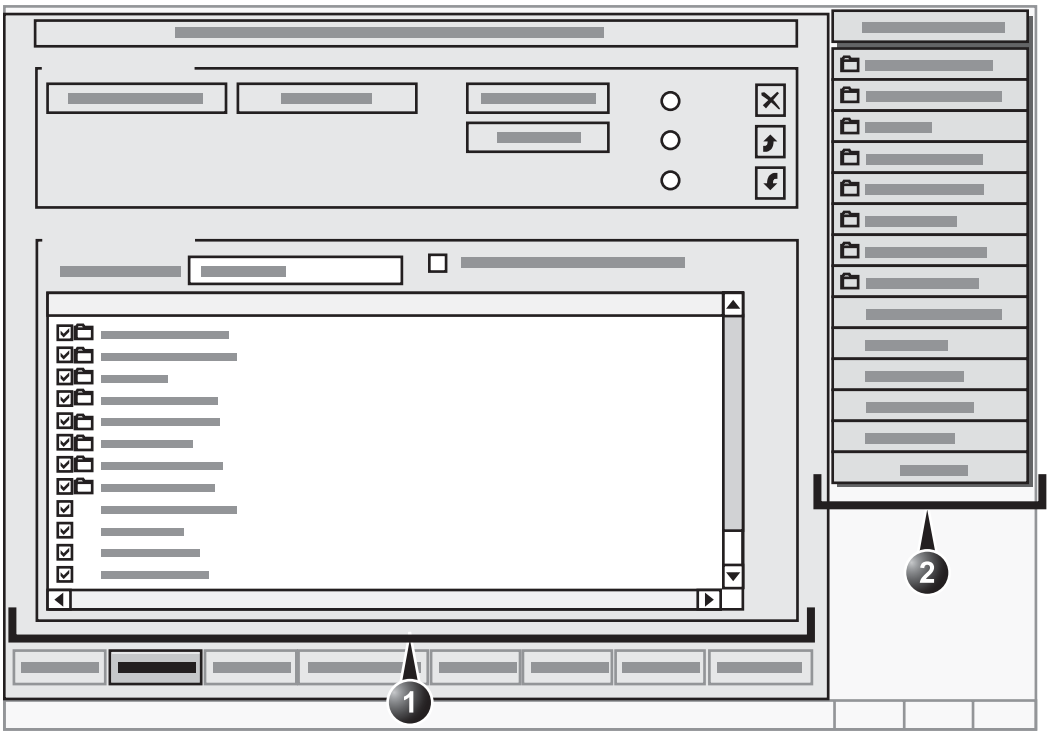
Measure/Text

The Measure/Text category deals with:

- Configuration of the *Measurement menu* (see page 294)
- Configuration of Measurement tools (see page 299)
- Configuration of the vascular Doppler calculation (see page 300)
- Creation of user-defined OB tables (see page 301)
- Configuration of the Annotation function

The Measurement menu sheet

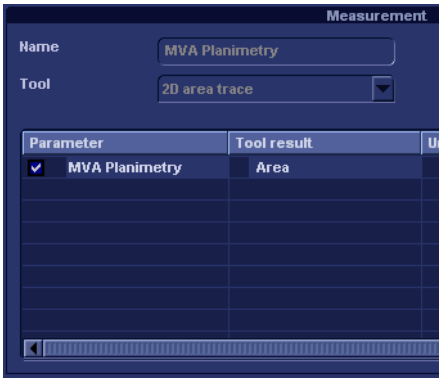
The *Measurement sheet* enables the organization of the Factory default *Measurement menu* and the creation of user-defined Measurements.



1. **Configuration window (see next pages for details)**
2. **The measurement menu (displays updated configuration)**

Figure 9-4: The Measurement menu setup sheet

Parameter	Description
	Add measure: Create or select from the pop-up list a measurement to be added to a folder (see page 167).
	Add folder: Enables the user to create its own folder with the desired measurements. The folder is displayed the *Measurement menu*.
	M&A Categories: • Enables selection of the measurement categories to display in the Measurement menu. Only checked items will be displayed. • **Create Copy**: Enables copy of a selected measurement category (selection is done by selecting the category name). • **Delete**: enables deletion of user-defined measurement categories. • **Factory Default**: restores factory display.
	2D, MM and Dop. radio buttons: Enables the display of mode related *Measurement menu* in the configuration window.

Parameter	Description
	Configuration tools: **Deletes** selected entry (folder or measurement) in the *Measurement menu*. The factory entries cannot be deleted. **Moves** selected measurement or folder up or down inside the *Measurement menu*.
	Folder: Displayed when a folder is selected in the *Measurement Menu*. Shows the entire contents of a selected folder. • ☑: The items is displayed in the *Measurement menu*. • ☐: The item is hidden from the *Measurement menu*.
	**Measurement:** Displayed when a measurement is selected in the *Measurement Menu*. Shows all the parameters related to the selected measurement. • ☑: The items is displayed in the *Measurement menu*. • ☐: The item is hidden from the *Measurement menu*. Only checked parameters will be displayed in the *Measurement result window*, the worksheet and the report.
	Auto sequence: ☑: Prompts the next measurement in the folder.

Configuration of the Measurement menu

Display of the Measurement categories

1. Press **M&A categories** in the *Configuration window*.
   The M&A categories are displayed in a pop-up window (see page 295).
2. Check the categories to be displayed.
   Uncheck the categories to hide.

To copy a Measurement category

1. Press **M&A categories** in the *Configuration window*.
   The M&A categories are displayed in a pop-up window (see page 295).
2. Select the M&A category name.
3. Press **Create copy**.
   A copy of the selected measurement category is displayed in the *Measurement menu*.

Factory Measurement categories cannot be renamed.

To rename the Measurement category:

1. Select the Measurement category in the *Measurement menu*.
2. **Enter** a new name in the Measurement field.

Selection of a Measurement category

1. Select to the Measurement menu heading.
   The measurement categories are displayed in a sub-menu.
2. Select to the measurement category of interest.
   The measurement category is displayed.

Moving an item in the Measurement menu

1. Select the entry to move into the *Measurement menu*.
2. Press or to move the selection up or down inside the *Measurement menu*.

Deleting an item in the Measurement menu

Only user created items can be deleted.

1. Select the entry to delete in the *Measurement menu*.
2. Press to delete the item.

Display/hide a folder or a measurement in the Measurement menu

The Measurement menu (Folders and Measurements) can be configured to display only the entries (folders and measurements) of interest.

To hide a folder or a measurement:

1. Uncheck the actual folder or measurement in the *Folder* or *Measurement field* in the *Configuration window*.

To display a hidden folder or measurement:

1. Check the actual folder or measurement in the *Folder* or *Measurement field* in the *Configuration window*.

Creating a user-defined folder

1. If the folder is to be inside another folder, select the actual folder in the *Measurement menu*.
2. Press **Add folder**.
   The *Measurement menu* is updated.
3. Select the new folder and Enter the folder name in the *Name text field*.

The Advanced sheet

The *Advanced sheet* enables further configuration of the Measurement function. The settings are divided into application specific parameters and global parameters.

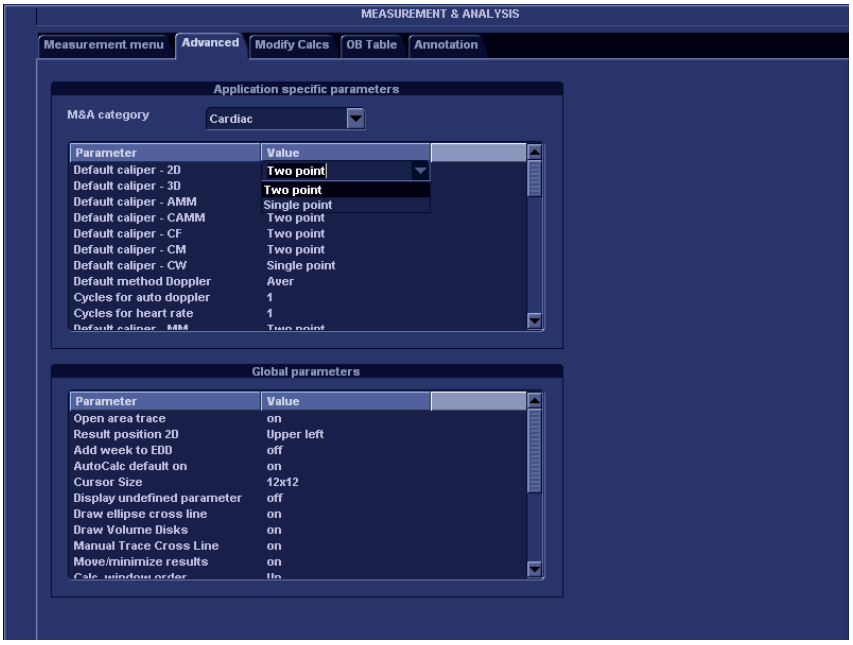


Figure 9-5: The Advanced sheet

Parameter configuration:

1. If configuring application specific parameters, select an application from the *M&A category pull-down menu*.
2. Select the configuration value next to the parameter to configure.
   A pull-down menu is displayed (see Figure 9-5).
3. Select a new value from the pull-down menu.

When pointing at a parameter an explanation label is displayed.

The Modify calculations sheet

The *Modify calculation sheet* is used to configure the calculations to be performed when doing a Doppler vascular measurements.

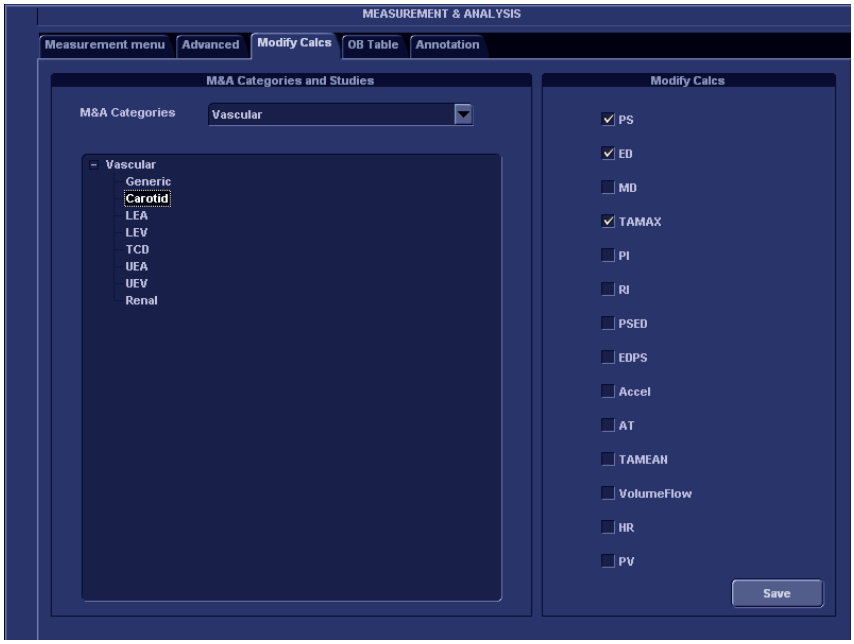


Figure 9-6: The Modify calculations sheet

The following example describes how to configure the Carotid Doppler calculations.

1. In the *Modify calculations sheet*, select **Vascular** next to *M&A Categories*.
   The *Vascular measurement category* is displayed.
2. Select **Carotid**.
   The available calculations are displayed.
3. Check the desired calculations to be performed.
4. Select **Save**.

The OB table sheet

The OB table sheet enables the creation and edition of user-defined OB tables.

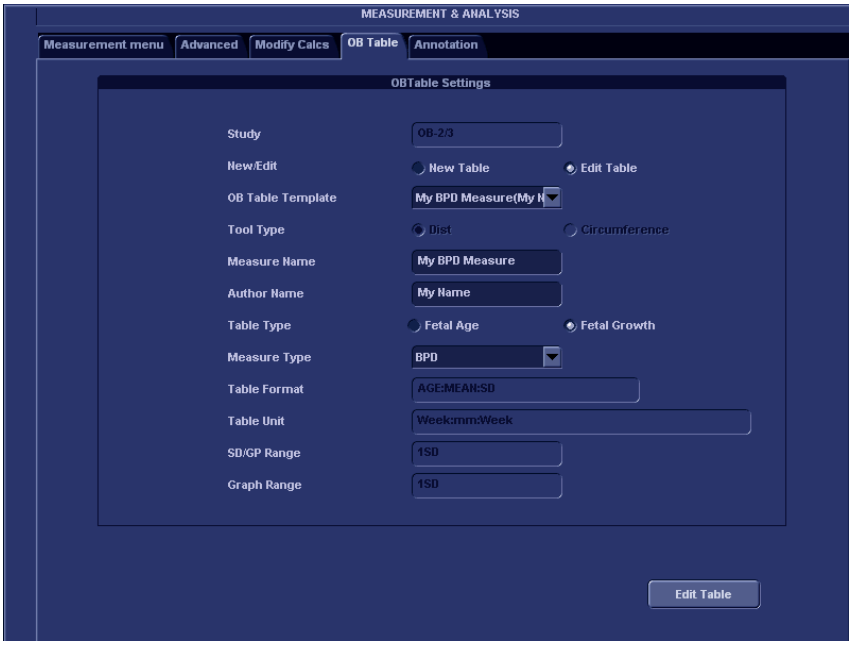


Figure 9-7: The OB table sheet

The following example describes how to create a fetal age OB-2/3 table based on Bi Parietal Diameter measurements.

1. In the *Measure/Text category*, select the **Measurement menu** sheet.
2. In the *Measurement menu sheet*, select **2D** mode.
3. Select the **OB table** sheet.
4. In the *Measurement menu*, select the category **Obstetrics** (Measurement menu heading) and the **OB-2/3** measurement study.
5. In the *OB table sheet*, check **New table**.
6. Enter or select the following:
   - **OB Table Template**: when creating a new OB table, select Template (1 - 7) which you want to use as the basis of the user programmable OB Table (see page 303).

When editing an existing user OB table, select the desired OB table to edit.

- **Tool type**: Select the type of measurement (e.g. Distance)
- **Measure Name**: type the name of measurement that will display in the *Measurement menu* (e.g. My BPD Measure).
- **Author Name**: Type the author's name (e.g. My Name).
- **Table Type**: If necessary, select the table type (e.g. Fetal Age).
- **Measure type**: select the desired measurement (e.g. BPD).

7. Select **Edit table**.
   The OB Table spreadsheet is displayed, showing the table template selected.

Figure 9-8: The Edit table spreadsheet

8. Enter the Min, Max and Interval values in the *Parameters field*.
   The system automatically fills in the *MEAS column*.
9. Enter the input values for the *MEAN* and *SD columns*.
10. Select **Exit to save**.

The OB table templates

Template 1 (based on Hadlock)				
Fetal age	format:	MEAS	MEAN	SD
	Unit:	mm	week	week
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	Min:	[#w#d]		
	Max:	[#w#d]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	week	mm	week
	Others are same as above			

Template 2 (based on Tokyo)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	day	day
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	SD:	[day (+/-)]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	day	mm	day
	Others are same as above			

Template 3 (based on Osaka)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	day	mm
	Table range:	1 SD		
	Graph range:	1 SD		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	SD:	[(mv-pv)/sd]		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	day	mm	day
	Others are same as above			

Template 4 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	5%–95%		
	Graph range:	5%–95%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	day
	Others are same as above			

Template 5 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	1 SD		
	Graph range:	5%–95%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	day
	Others are same as above			

Template 6 (based on several European tables)					
Fetal age	Format:	MEAS	MIN	MEAN	SD
	Unit:	mm	weekday	weekday	weekday
	Table range:	10%–90%			
	Graph range:	10%–90%			
Measurement result	Value:	[cm]			
	GA:	[#w#d]			
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.			
Fetal growth	Format:	AGE	MIN	MEAN	SD
	Unit:	weekday	mm	mm	mm
	Others are same as above				

Template 7 (based on several European tables)				
Fetal age	Format:	MEAS	MEAN	SD
	Unit:	mm	weekday	mm
	Table range:	1 SD		
	Graph range:	10%–90%		
Measurement result	Value:	[cm]		
	GA:	[#w#d]		
	GP:	[%] Calculated by Fetal growth table. If Fetal growth table is not edited, GP is not calculated.		
Fetal growth	Format:	AGE	MEAN	SD
	Unit:	weekday	mm	mm
	Others are same as above			

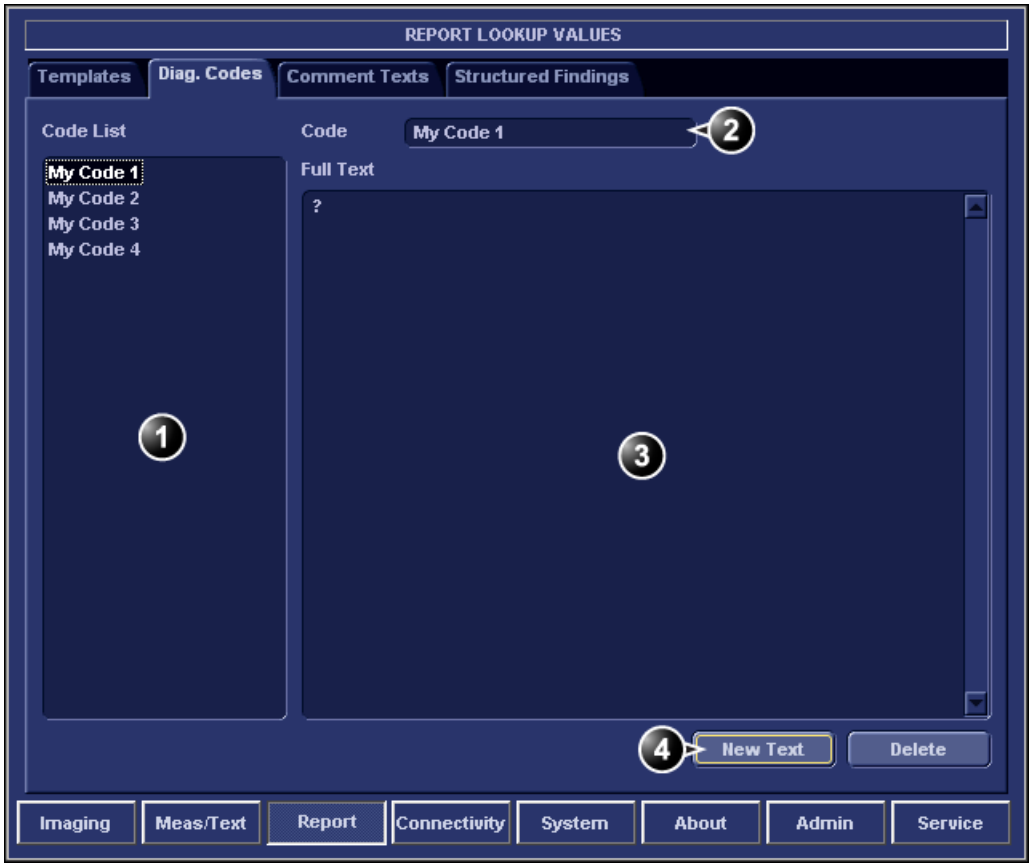
Report

The *Report configuration category* is divided in three sheets:

- **Templates**: enables the configuration of the *Template selection menu* and the export/import of user-defined templates. See ’Report templates management’ on page 280 for more information.
- **Diagnostic codes**: enables the creation of pre-defined text inputs to be used in the *Diagnosis information field* in the *Examination list window* (see Figure 2-2, page 15).
- **Comment texts**: enables the creation of pre-defines text inputs to be used in the *Comment information field* in the *Examination list window* (see Figure 2-2, page 15).
- **Structured findings**: enables the insertion of pre-configured structured diagnosis statements and Billing/Accreditation codes in the patient report (see ’Structured Findings’ on page 247).

The diagnostic codes sheet

This sheet enables the creation (and deletion) of text inputs that can be used when entering diagnostic codes in the *Examination list window* (see Figure 2-2, page 15).



1. **List of text inputs**
2. **Text input name**
3. **Text input display area (free text area)**
4. **Create a text input**

Figure 9-9: The Diagnostic codes sheet

Creating a text input

1. Press **New Text** (see Figure 9-9).
2. In the *Code field* enter a name for the text input.
3. Move the **Mouse cursor** in the *Text input display area*.
4. Press the **Left mouse button**.

5. Enter the text.
   The new text input is created and can be selected when entering diagnostic information in the *Examination list window* (see page 17 for more information about diagnostic information entry).

Deleting a text input

1. In the *Code list field*, select the text input to delete (see Figure 9-9).
2. Press **Delete**.

The Comment texts sheet

This sheet enables the creation (and deletion) of text inputs that can be used when entering comments in the *Examination list window* (see Figure 2-2, page 15).

Figure 9-10: The Comment texts sheet

Refer to ’Direct report’ on page 90 for more information on creating, editing and deleting comment text inputs.

Connectivity

This configuration setup category deals with:

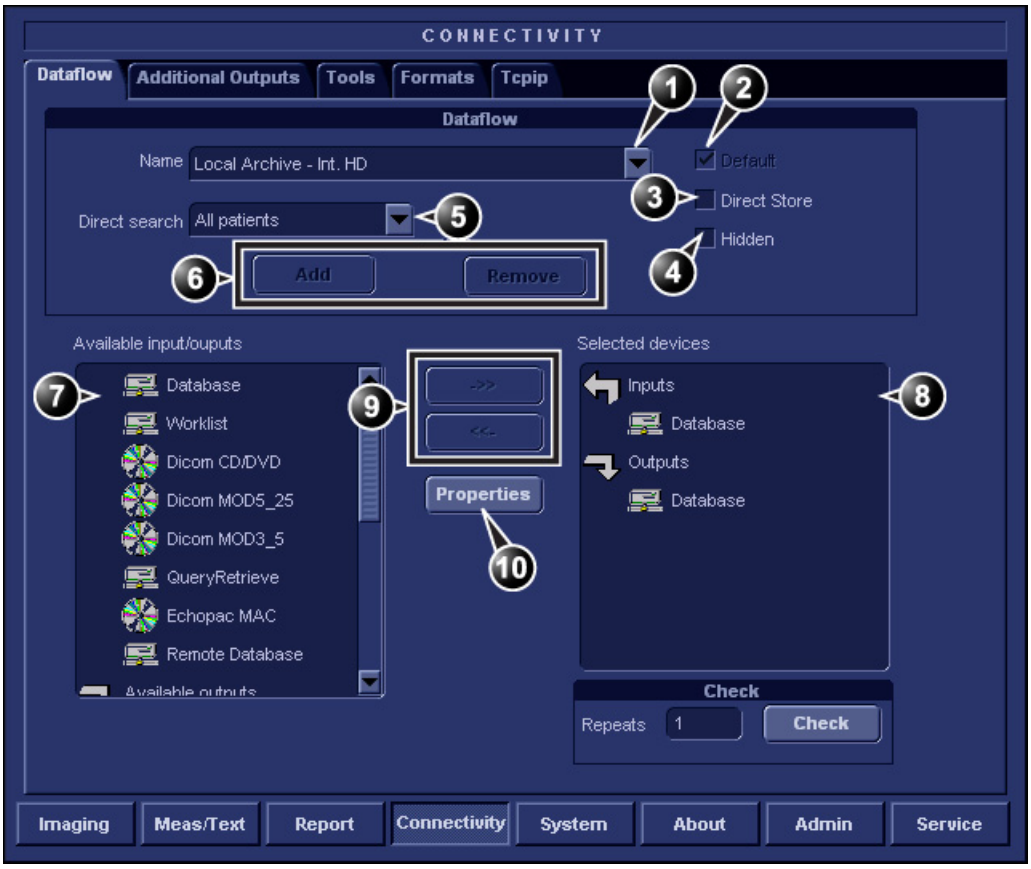
- **Dataflow**: connection and communication setup of the EchoPAC PC with other devices.
- **Additional outputs**: configuration of the **Alt. Store 1** and **Alt. Store 2** buttons.
- **Tools**: formatting of removable media
- **Formats**: configuration of the *Examination list window* and other tools related to patient management.
- **TCPIP**: internet protocol configuration

Dataflow

Communication between the EchoPAC PC and other information providers on the network takes the form of dataflows. Each dataflow defines the transfer of patient information and images from an input source to the workstation, and from the workstation to an output source.

A dataflow is a set of pre-configured settings. Selecting a dataflow will automatically customize the unit to work according to the settings associated with this dataflow.

Dataflows are configured in the *Dataflow sublevel sheet* in the *Connectivity setup category* as described below. The *Dataflow sublevel sheet* is only available to users with administration rights.



1. **Select a dataflow to configure**
2. **Use selected dataflow as default**
3. **Store data directly to archive**
4. **Hide selected dataflow from the list of available dataflow**
5. **Option for the search function. In the Search/Create patient window select between None, All patients and Today's patient**
6. **Add/Remove a user-defined dataflow (available with Service Dongle only)**
7. **Available input/output devices that can be assigned to the current dataflow**
8. **Input/output devices assigned to the current dataflow**
9. **Add/remove selected device to/from the current dataflow (user-defined dataflows only)**
10. **Adjust the settings for the selected assigned device**

Figure 9-11: The sublevel Dataflow (example)

Dataflows available

A set of pre-defined dataflows is available on the unit as listed in the table below. Input/output devices cannot be

added/removed to/from the pre-defined dataflows. However the settings for the devices can be adjusted (see page 317).

	Dataflow	Description
	No Archive	Enables to perform an examination without storing the data to the archive.
	LocalArchive-Int.HD	**Local archive internal harddrive** The local database is used for patient archiving. Images are stored to internal harddrive.
	LocalArchive-MOD	**Local archive Magneto Optical Disk (MOD)** The local database is used for patient archiving. Images are stored to a MOD.
	RemoteArch-RemoteHD	**Remote archive remote harddrive** A remote database (either on EchoPAC workstation or on EchoServer) is used for patient archiving. Images are stored to a network image volume (either internal HD on EchoPAC workstation or EchoServer volume).
This dataflow cannot be used with an ImageVault 3.0 server.	**RemoteArchive-MOD**	**Remote archive Magneto Optical Disk** A remote database (either on EchoPAC workstation or on EchoServer) is used for patient archiving. Images are stored to a MOD.
	DICOM MOD 3.5	DICOM 3.5" Magneto Optical Disk Read DICOM Media from the 3.5" MO-drive. Some of the measurements are stored if DICOM SR is turned on.

	Dataflow	Description
	DICOM MOD 5.25	DICOM 5.25" Magneto Optical Disk Read DICOM Media from the 5.25" MO-drive. Some of the measurements are stored if DICOM SR is turned on.
	DICOM CD/DVD read	DICOM CD read Read DICOM Media from the CD-drive. Read only dataflow, no data can be stored.
EP MAC MOD: the MOD must be PC-formatted. Only images can be read.	**EchoPAC Mac MOD read**	EchoPAC Macintosh Magneto Optical Disk read Read MOD from EchoPAC (Macintosh). Read only dataflow, no data can be stored.
	Query Retrieve	Query Retrieve Retrieve images from a DICOM server

To select the default dataflow

1. Select the dataflow in the *Name drop-down menu*. (see Figure 9-11).
2. **Check** the *Default box*.
   The dataflow will be selected by default when restarting the unit.

To create a new dataflow

1. Press **Add**.
   The *Add dataflow window* is displayed.

Figure 9-12: The Add dataflow window

2. Enter a name for the new dataflow.
3. Press **OK**.
4. Select an **Input device** in the *Available inputs/outputs field* and press the **Right arrow button** to assign the service to the dataflow.
5. Repeat step 4 to assign input/output devices as desired. Most dataflows consist of one input device and one or several output devices. However in two cases it is possible to have two input devices, when defining a dataflow with DICOM Worklist or DICOM Query/Retrieve in combination with a database.
6. Adjust the device's parameters as described below.
7. To remove a device from the dataflow, select the device in the *Selected devices field* and press the **Left arrow button**.

Adjusting the assigned devices

1. Select the device in the *Selected devices field*.
2. Press **Properties**.
   The *Properties window* is displayed.
3. Adjust the device specific parameters as desired (see table below). Not all the settings listed below apply to all devices.

General settings	Definition
Name	Free text: give a descriptive name for the device.
IP address	Select from drop-down menu
Database Name	Automatically selected according to the IP address
File destination	Automatically selected according to the IP address
Removable	Check the entry is the media is removable.
MPPS	Modality Perform Procedure Step: send information (typically to a HIS) that a scheduled exam has been started, performed or interrupted.

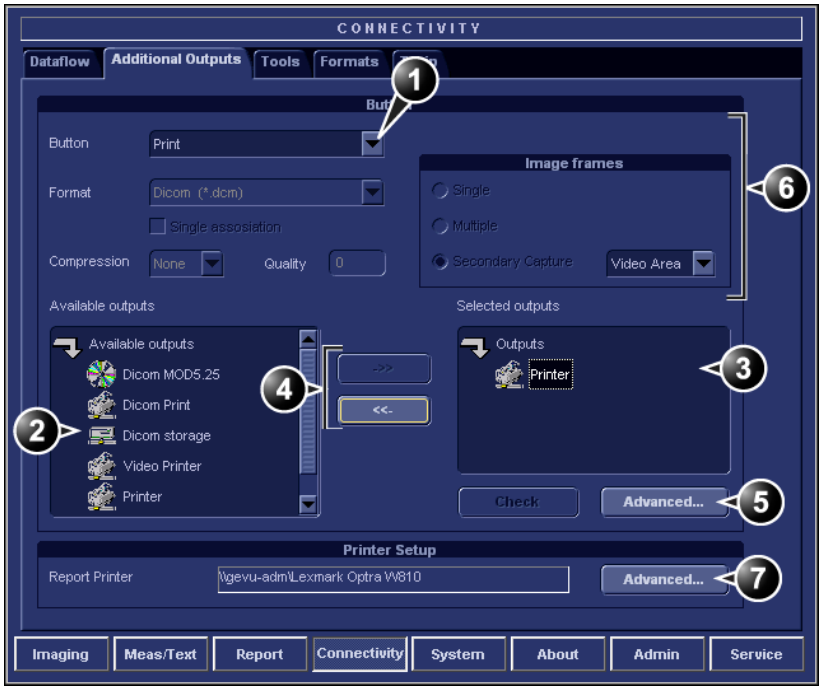
Image settings	Definition
Allow raw data	☑: Save data in both raw and DICOM format. ☐: Save data in DICOM format only.
Raw Compression	Enables compression of raw data images upon storage and export. Raw compression is active only if the setting *Allow raw data* is checked.
Max Frame rate	Select 25, 30 or Full (original acquisition) from the pop-up menu.
Compression	Select compression type or no compression.
Quality	Set picture quality from 1 to 100%. A low picture quality level allows high data compression, while a high picture quality restrains the compression.
Allow Multiframe	☑: Allow cineloop storage.

Connection settings	Definition
Retry	Set maximum number of connection tentative, time interval between tentative and time-out.

DICOM settings	Definition
AE Title	The Application Entity Title is set during DICOM configuration. Refer to the network specifications.
Port	The Port no. is allocated during DICOM configuration. Refer to your network specifications.
Verification	Verify the connection to another DICOM application
Storage commitment	Send a request to a PACS, asking it to permanently archive image(s)
MPPS	Modality Perform Procedure Step: send information (typically to a HIS) that a scheduled exam has been started, performed or interrupted.

Additional outputs

The *Button sheet* deals with configuration of the **Alt. store 1** and **Alt. store 2** buttons. Several outputs (e.g. Video Print, Laser print, DICOM storage...etc.) can be associated to these buttons (i.e. pressing **Alt. store 1** or **2** can result in printing a Color video print and storage to a DICOM media).

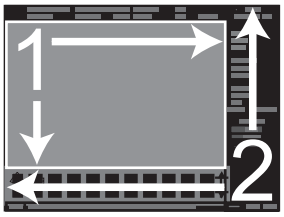


1. **Select between Alt. store 1 and Alt. store 2 buttons.**
2. **Available output devices that can be assigned to the current button.**
3. **Output devices assigned to the current button.**
4. **Add or remove selected device to/from the current button.**
5. **Adjust the device settings for the selected assigned device**
6. **Select the type of images to produce and adjust image settings.**
7. **Printer configuration**

Figure 9-13: The sublevel Additional outputs (example)

Alt. store 1 / Alt. store 2 button configuration

1. In the *Button field* select **Alt. store 1** or **Alt. store 2**.
2. Select an **output device** in the *available outputs field* and press the **Right arrow button** to assign the service to the dataflow.
   The *Properties window* for the selected device is displayed.
3. Adjust the device specific parameters and select **OK**.
4. Adjust the image specific parameters (see table below).

Configuration parameter	
Format	Select between: • Raw DICOM • DICOM
Image compression	Select compression mode from the pop-up menu.
Quality	When JPEG compression is selected, adjust the picture quality between 1 and 100%. A low picture quality level allows high data compression, while a high picture quality restrains the compression.
Image frames	Select between: • **Single**: stores single frame only • **Multiple**: stores cineloop • **Secondary Capture**: screen shot
Capture Area	Select between: • Video Area (1) • Whole Screen (2) 

To remove a device, select the device in the *Selected devices field* and press the **Left arrow button**.

Tools

The *Tools sublevel sheet* deals with:

- formatting of removable media (MO disk, CD-R, DVD-R or ZIP disk), see page 26.
- Creation or re-creation of a DICOM directory on a removable media containing DICOM images.
- Enter a remote path of a network shared folder (\\server-name\share-name) for:
  - Export traces function in Q-Analysis
  - Export of system error log file
  - Save as function for images

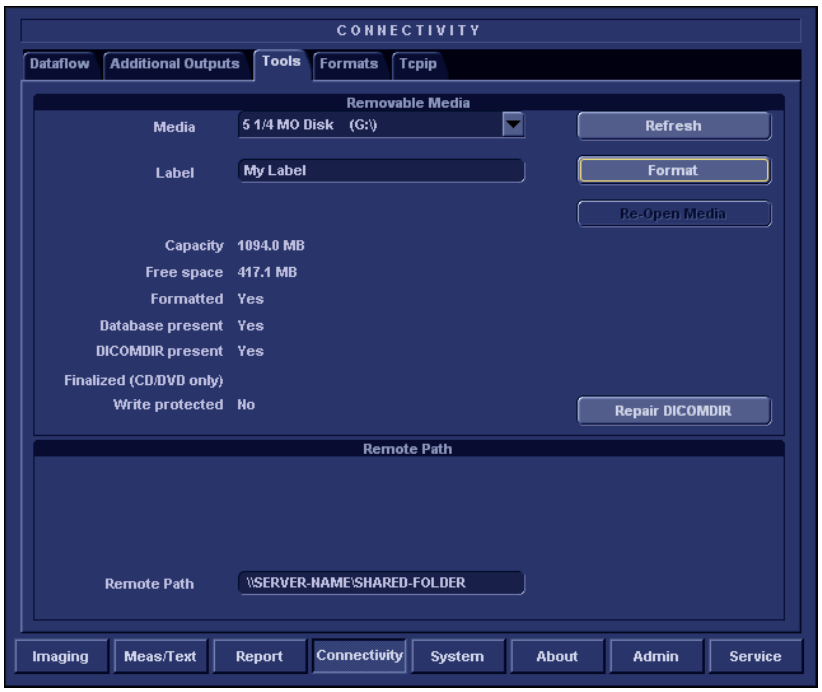


Figure 9-14: The sublevel Tools

Creation of a DICOM directory

1. Insert the media in the drive.
2. Select **Repair DICOM DIR**.
   Wait for the display of the *Information window* indicating that the process is completed.

Formats

The Formats sublevel enables configuration of the *Examination list window* (see Figure 2-2, page 15) and other tools related to patient management, as described below.

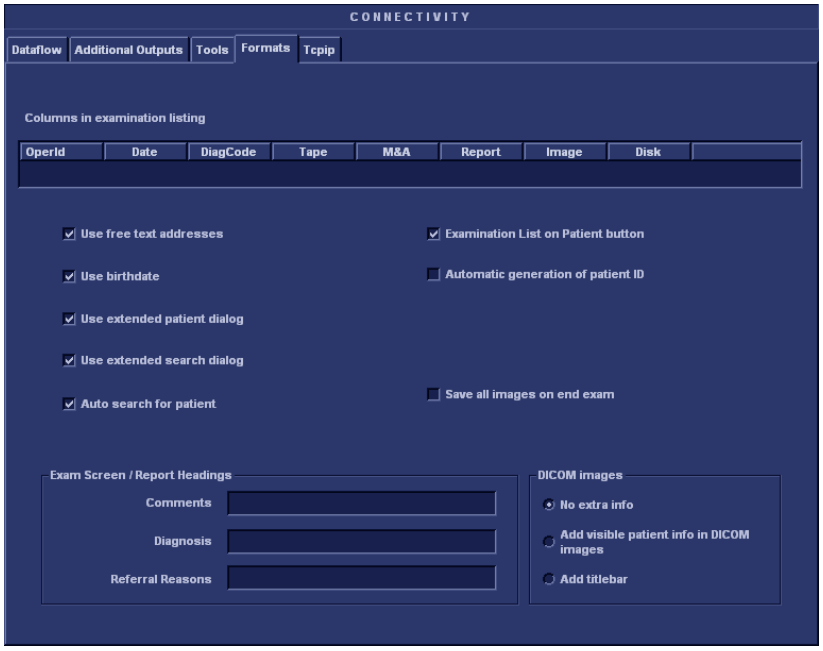


Figure 9-15: The sublevel Formats

Configuration of the Examination list window

The user can configure the examination list displayed in the *Examination list window* (see Figure 2-2, page 15) by deleting, adding columns and change the information type displayed in each column.

Column configuration

To adjust column width, select and drag column heading border.

1. Select to the column to edit.
   A sub-menu is displayed (see Figure 9-16).
2. Select the action to perform:
   - **Insert**: creates a new column
   - **Delete**: removes selected column
   - select the desired information to be displayed in the selected column.

1. **Insert new column to the left of the selected column**
2. **Delete selected column**
3. **Select column heading**

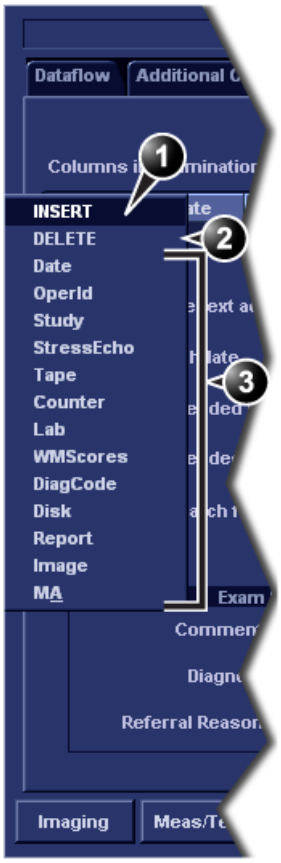
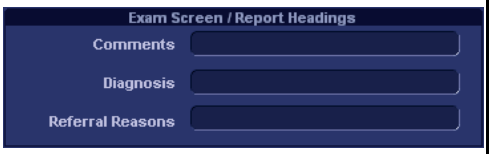


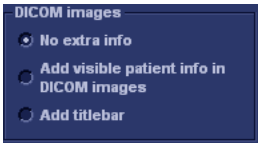
Figure 9-16: Configuration of the Examination list window

Other configuration settings

Parameter	Description
☑ Use free text addresses	**Use free text addresses:** In the *Patient information window* (see Figure 2-5, page 21), ☑: The address information (e.g. street, city...etc.) is entered in type-specific fields. ☐: The address information is entered in a single field (free text).

Parameter	Description
☑ Use birthdate	**Use Date of birth:** In the *Patient information window* (see Figure 2-5, page 21), enter either the patient age or the birth date: ☑: Enter age (Date of birth field not available) ☐: Enter Date of birth, the age is calculated.
☑ Use extended Patient dialog	**Use extended patient dialog:** In the *Patient information window* (see Figure 2-5, page 21), ☑: The entire patient information data is displayed. ☐: Patient information data displayed is restricted to a minimum (e.g. name and Patient ID). When unchecked, press **More** to display the entire patient information data.
☑ Use extended search dialog	**Use extended search dialog:** In the *Search/Create Patient window* (see Figure 2-1, page 14), ☑: All the searching filters are displayed as default. ☐: The searching criteria are restricted to a minimum. When unchecked, press **More** to display all the searching filters.
☐ Auto search for patient	**Auto search for patient:** In the *Search/Create Patient window* (see Figure 2-1, page 14) ☑: The system searches automatically through the patient archive selected while entering patient information. ☐: The system searches through the patient archive after pressing enter.

Parameter	Description
	Pre-defined text directly: In the *Examination list window* (see Figure 2-2, page 15) ☑: the **Insert text** button launches pre-defined text input. ☐: the **Insert text** button open the extended text field.
	Examination list on Patient button When a patient is selected, pressing **Patient** will: ☑: open the *Examination list window* for the selected patient. ☐: open the *Patient Information window* for the selected patient.
	Automatic generation of patient ID: In the *Search/Create Patient window* (see Figure 2-1, page 14) ☑: Patient ID is not required when entering a new patient in the archive. EchoPAC PC generates automatically an ID number. ☐: Patient ID is required when entering a new patient in the archive.
	Save all images on end exam: ☑: All images on the clipboard are automatically saved when ending an examination. ☐: A dialogue window is displayed when ending an exam where the user can select between: • Store all images • Select images to store • Store no images
	**Exam screen/Report headings:** Enter user-defined headings for Comments, Diagnosis and Referral reasons fields.

Parameter	Description
	**DICOM images:** Select between: • **No extra info** • **Add visible patient info in the DICOM images**: displays patient information (name, date of birth and ID) on DICOM images. • **Add titlebar**: adds the Titlebar to the DICOM images.

TCP/IP

This configuration category enables the user with administration rights to set the Transmission Protocol/Internet Protocol for the system and connected remote archive.

1. **Computer name: device's name of type VIVID7-00nnnn or ECHOPAC7-00nnnn, where "nnnn" is the system's serial number. Do not change the computer name.**
2. **IP settings: system IP settings**
3. **Remote archive setup: remote archive IP address and name (EchoPAC PC or EchoServer)**
4. **Save TCP/IP settings. The changes will be effective after the system is rebooted.**
5. **Advanced DICOM log: creates a detailed DICOM related report log. Should be used only if DICOM issues are registered (see page 376 about report log generation).**

Figure 9-17: The sublevel TCP/IP

System

This configuration category is divided in two sheets:

- **System Settings**: enables the user to set the date and time, choose the measurement unit and language for the system and enter basic information about the organization, such as the institution name and department.
- **Test**: enables testing of the different parts of the unit.

This sheet is accessible to users with administration rights only.

The system settings

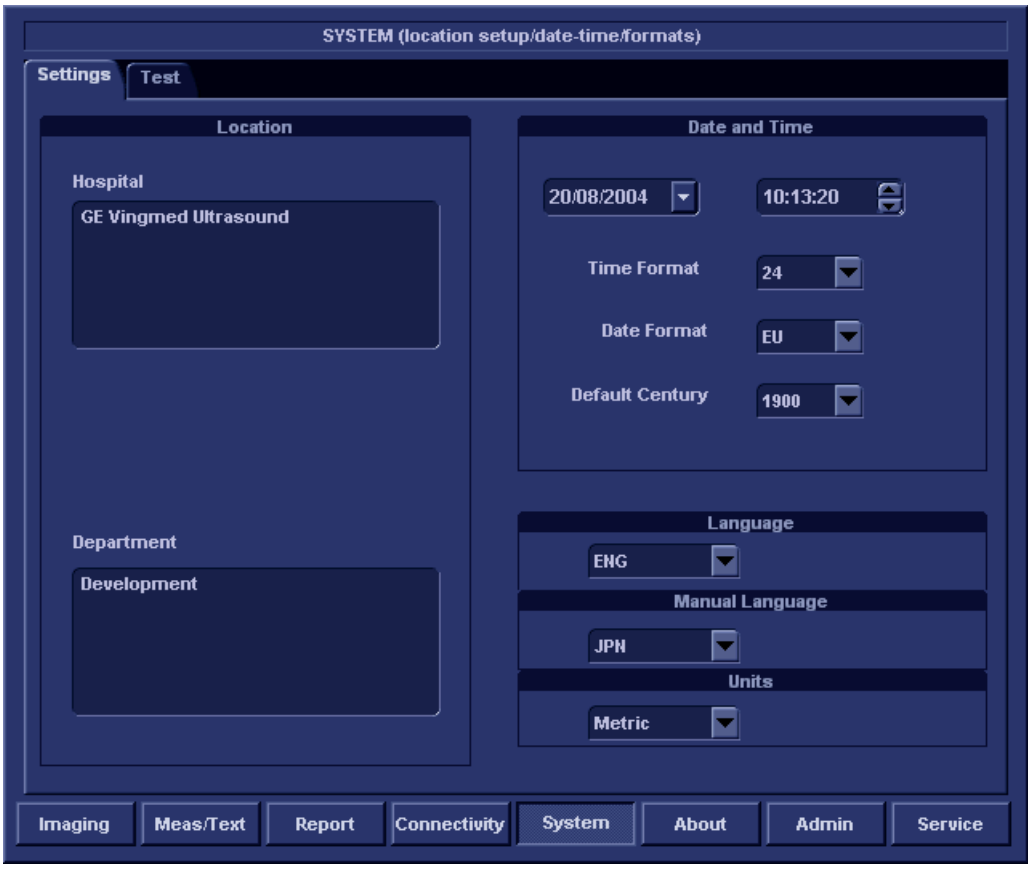
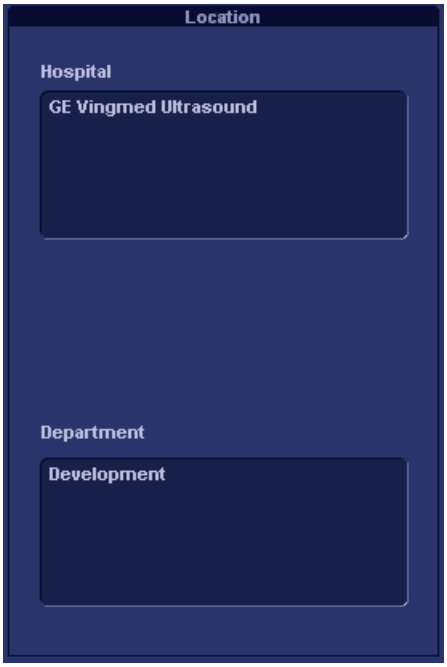
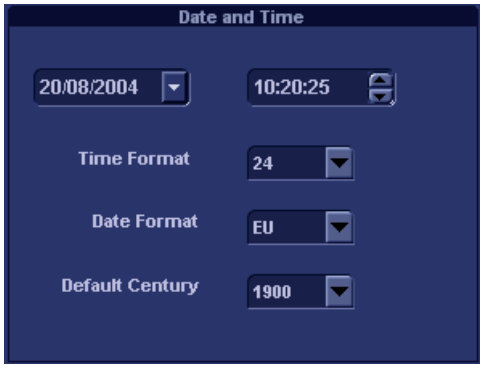


Figure 9-18: The System settings setup sheet

Location

Parameter	Description
	**Location:** • **Hospital**: Enter the hospital name (up to 64 characters). This information is displayed on the *Title bar* (up to 24 characters) and on the image properties of all saved images. • **Department**: Enter the department name (up to 64 characters). This information is displayed on the image properties of all saved images.

Date and Time

Parameter	Description
 Changes done on the date or time format will be effective only after rebooting the system.	**Date and Time:** • **Date**: sets the date. Select the correct date from the pop-up window. • **Time**: sets the time. Press the arrow head buttons to set the time (hour minute and second). • **Time Format**: select the desired format (24 or 12AM/PM) from the pop-up menu. • **Date Format**: select the desired format (EU or US) from the pop-up menu. • **Default Century**: select the desired format (1900, 2000 or None) from the pop-up menu. **1900**: the number 19 is automatically displayed when entering the year in the patient date of birth (to edit century, press **Backspace** twice). **2000**: the number 20 is automatically displayed when entering the year in the patient date of birth (to edit century, press **Backspace** twice). **None**: the four digits have to be typed when entering the year in the patient date of birth.

Languages

Parameter	Description
 Changes apply after rebooting the system.	**Language:** Select the desired language for the system from the pop-up menu. **Manual language:** Select the desired language for the Online manual. If not available the English manual will be displayed as default.

Units

Parameter	Description
	Units: Select the desired units (Metric or US) from the pop-up menu.

About

The *About sheet* gives informations about the ultrasound unit concerning:

- software
- hardware

Administration

Only users with administration rights have access to this setup category (see page 335).

The Admin. category deals with:

- **Disk management**: enables the management of the hard disk space while maintaining the patient database on the system (see page 42).
- **Backup**: enables the backup procedures for local patient, image and report archives as well as EchoPAC PC configuration settings (see page 50).
- **Restore**: enables data retrieving of patient and report archives as well as EchoPAC PC configuration settings (see page 50).
- **Users**: deals with operators registration, operator's rights setting and registration of staff related to an examination (e.g. referral doctors, sonographers...etc.).
- **System Administration**: keeps track of all the options implemented in the unit.
- **Unlock patient**: enables to unlock patient records that were not properly terminated.

Users

The *Users sheet* deals with operators registration, operator's rights setting and registration of staff related to an examination (e.g. referring and interpreting physicians).

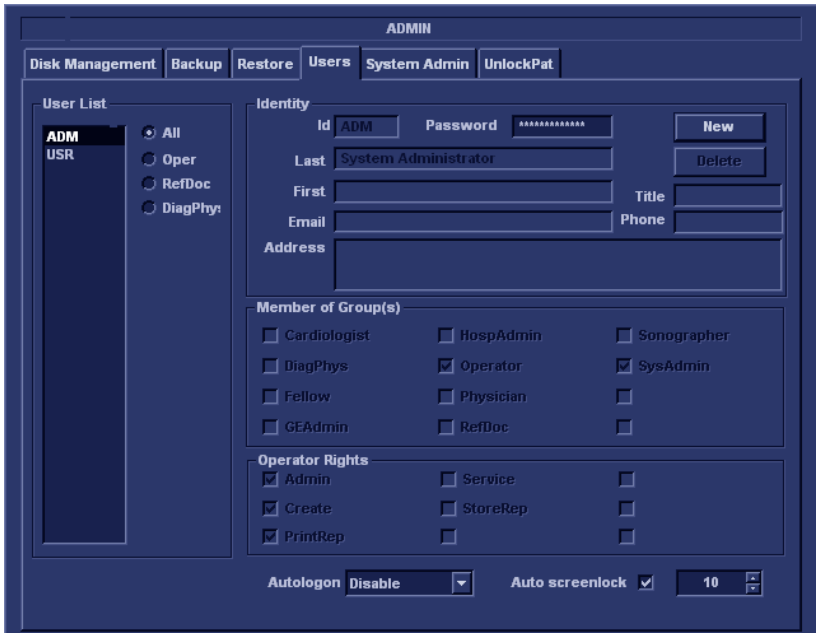


Figure 9-19: The Users setup sheet

Users are divided in groups with different rights. There are two types of groups:

- **User groups**: members of these groups (see table below) are allowed to login on the system when selected together with the group Operator. They have group specific rights.
- **Referring groups**: members of these groups (Diagnosing physician and Referring doctor) are not allowed to login on the system. They are registered as references that can be associated to a patient record.

	Right (see definition below)				
Group	**Create**	**Print report**	**Store report**	**Admin**	**Service**
Cardiologist	+	+	+		Activated with a Dongle
Physician	+	+			
Sonographer	+	+			
Fellow	+	+			
Sys Admin	+	+		+	
Hosp admin		+			
GE admin	+	+		+	

The rights associated to the user groups are:

Right	Definition
Create and delete	• Create, update and delete a patient record • Create, update and delete an examination • Create, update and delete an user or a referring member • Import/Export patient records, examinations • Move examinations
Print report	• Print a report
Store report	• Store a report
Admin	• System administration
Service	• Access to the service platform

Creating a user or a referring member

1. Press **New**
2. Enter the user's information.
3. Select the type of user/referring member in *Member of Group(s)*.

△
CAUTION

To be able to login on the system, the group Operator MUST be selected.

Editing an user configuration

1. Select the actual user in the *User list*.
2. Make the desired changes.
3. Press **Archive** to exit the Configuration management package.

Deleting a user

1. Select the actual user in the *User list*.
2. Press **Delete**.
   The user is removed from the *User list*.

Auto logon and Auto screenlock

Auto logon

1. Select the desired logon setup from the pull down menu:
   - **Disabled**: no default user is selected when logging on.
   - **Last user**: the last user is selected automatically when logging on.
   - **A specific user**: select one of the users to be the default user when logging on.

Auto screenlock

1. Set the time span (from 10 min) for the system to automatically get locked when not in use. When the system is locked, the current user may either log on again or the system may be restarted by a different user.

Unlock Patient

If for any reason an examination is not properly finished, the patient record is locked and cannot be opened again unless it is unlocked.

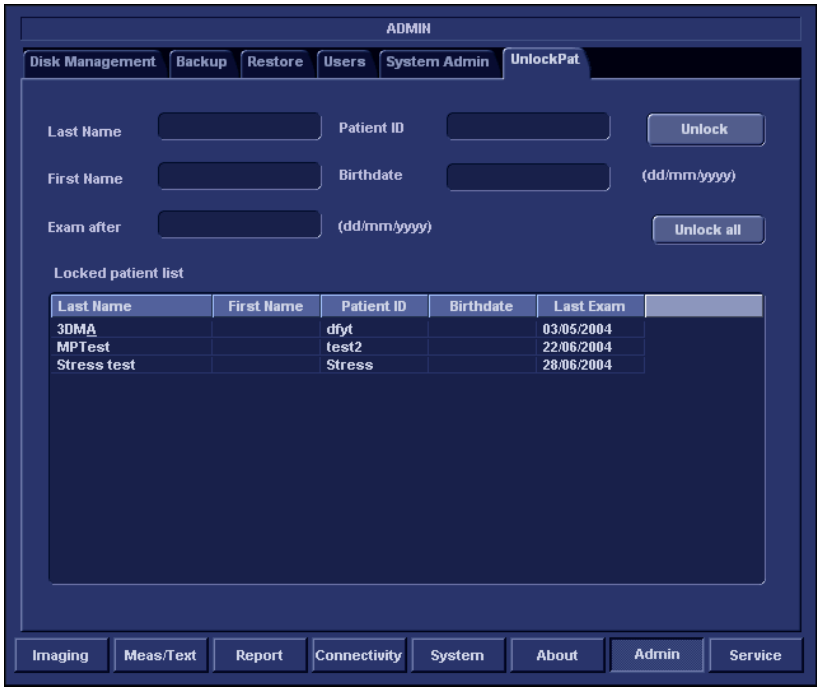


Figure 9-20: The Unlock patient sheet

To unlock patient records:

1. Press **CONFIG** (**F3**).
2. Select the category **Admin**.
3. In the *Admin category*, select the sheet **Unlock Patient**.
4. In the *Unlock Patient sheet*, select the patient record(s) to unlock.
   You can search for a specific patient record or a group of patient record using the searching filters.
5. Select **Unlock** to unlock the selected patient record(s) or select **Unlock all** to unlock all patient records.
   A *Confirmation window* is displayed.
6. Select **OK**.

Chapter 10
2D Strain

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Introduction

2D Strain is an advanced research option on EchoPAC PC allowing global and regional quantitative evaluation of the myocardial function. 2D Strain enables calculation of myocardial tissue velocity and deformation parameters based on tissue tracking from 2D grey scale and/or 2D tissue Doppler (TVI) images.

Acquisition

2D Strain can be applied to 2D grey scale or TVI acquisitions. In both cases, the 2D grey scale frame rate should be between 40 and 90 frames per second.

Note: in TVI images the system reports TVI frame rate. It is the 2D grey scale frame rate that must be between 37 and 80 frames per second. A higher frame rate is recommended for high heart rate.

Use only images of good quality where the entire myocardium is visible.

1. Select a TVI or 2D acquisition.
   The image quality should be reasonably good, all myocardial segments to be analyzed should be clearly visible on each frame.
2. If the acquisition has more than one heart cycle, select Cineloop and select a single heart cycle (see also page 86).
   The scanner should be configured to store heart cycles with 100 milliseconds before and after the R-wave (in Config/Global).

Starting 2D Strain

1. In the Advanced control panel, select **Q Analysis**.
   The *Quantitative analysis screen* is displayed.
2. Select **2D Strain** to start the application.
   The *Choose view window* is displayed.

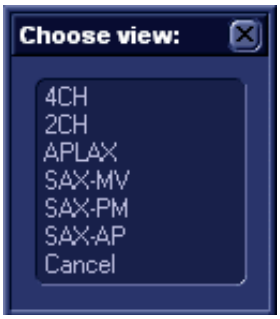


Figure 10-1: The Choose view window

3. Select the correct view type.
   It is recommended to start with the APLAX view. This will allow the user to adjust the Aortic Valve Closure (AVC) to define end of systole. The AVC setting will then be used in the other views.

Defining a ROI

Once the view type has been selected, a Region of Interest (ROI) must be created. The ROI is created either by manual outlining of the endocardial border or by placing three points at the endocardial corners: two basal points and one apical point (Auto ROI, only for full apical views, not for short axis views and single wall). When using manual outlining, the user may trace the entire myocardial or a single wall.

The system automatically displays a frame at end-systole and the mouse arrow cursor is changed to a pencil cursor .

1. If required, adjust **Ref. Frame** to display another frame at end-systole.

Manual outlining

1. Place the cursor at the starting point (as indicated next to the pointer) and press the Left mouse button.
2. Move the cursor following the endocardial border and press the Left mouse button to place a new point. By creating several points the outlining trace can be bent to follow the endocardial border (see 'Guidelines for the ROI definition' on page 343 for additional information).

The **Yo-yo** runs back and forth display around the reference frame. This may help finding the endocardial border.

3. When placing the last point, double-click the Left mouse button to end the trace.
   A ROI following the endocardial border is displayed.
   Data processing is started automatically if the cursor is not moved for a few seconds.
   Note: The auto processing function is configurable (from Config/Meas-Text/Advanced/AFI auto processing.)

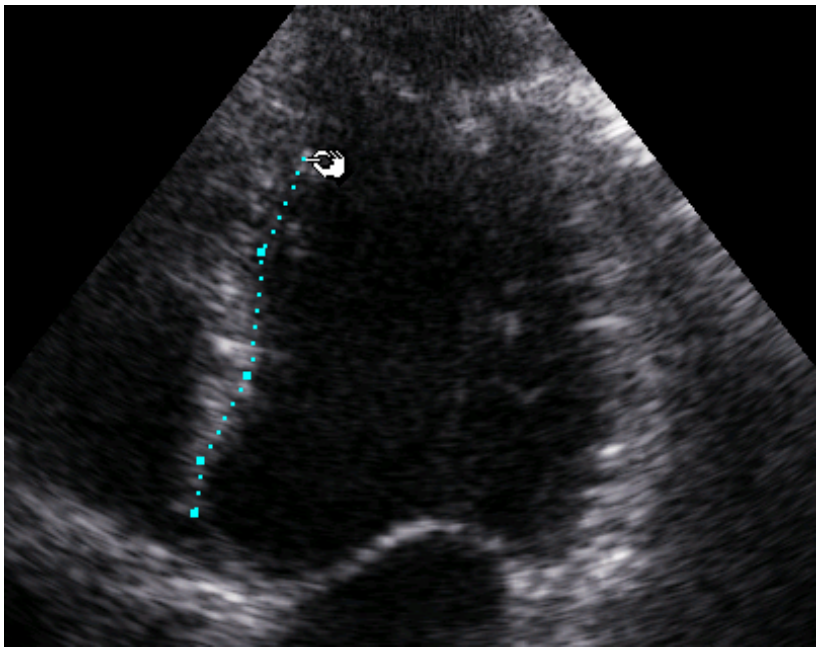


Figure 10-2: Tracing the Region of Interest (ROI)

Note: In a SAX view the trace should be closed.

Auto ROI

1. Place the cursor at the first basal point (as indicated next to the pointer) and press the Left mouse button.
2. Place the cursor at the Apex and press the Left mouse button.
3. Place the cursor at the other basal point and double-click on the Left mouse button.
   A ROI following the endocardial border is displayed.

Data processing is started automatically if the cursor is not moved for a few seconds.
Note: The auto processing function is configurable (from Config/Meas-Text/Advanced/AFI auto processing.)

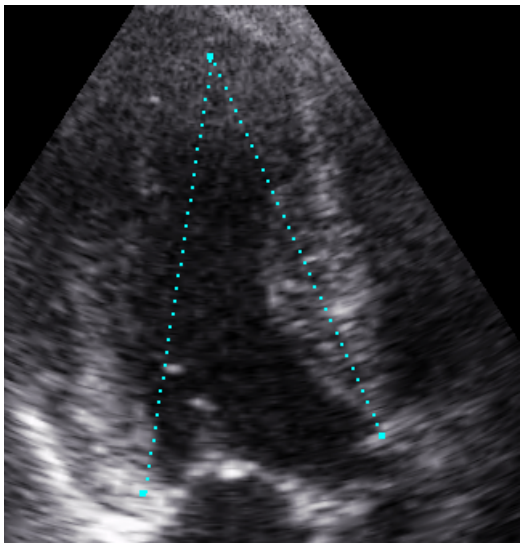
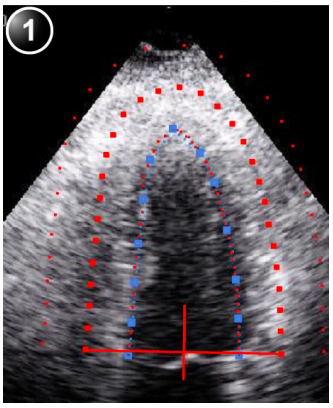
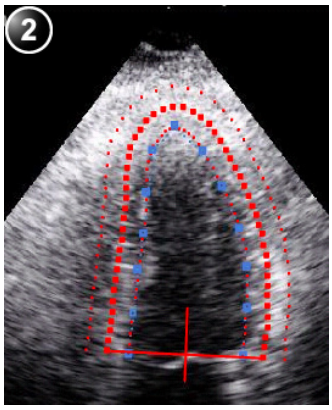
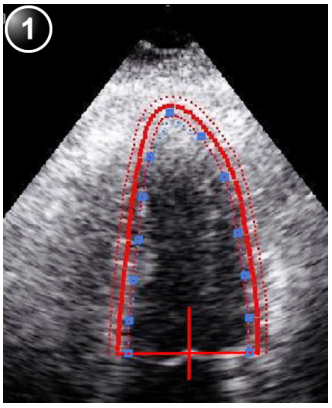
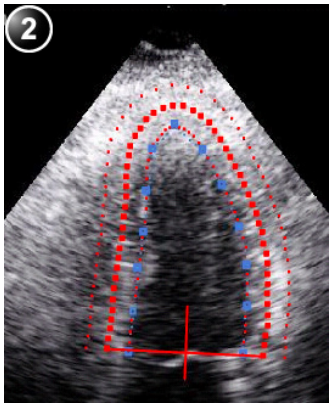
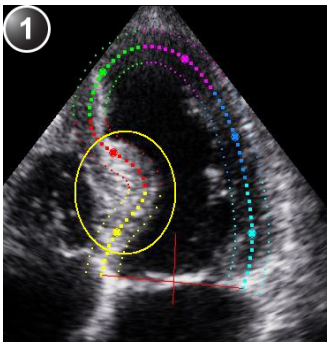
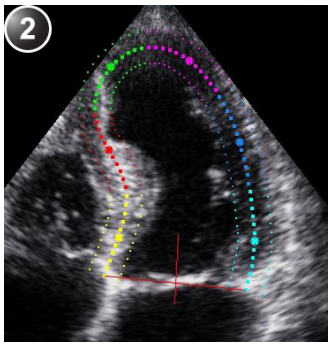


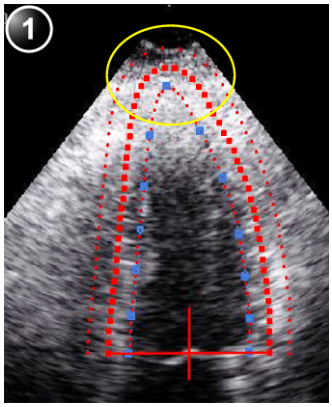
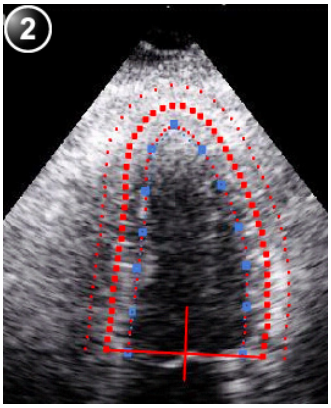
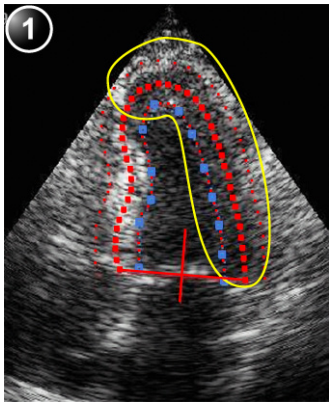
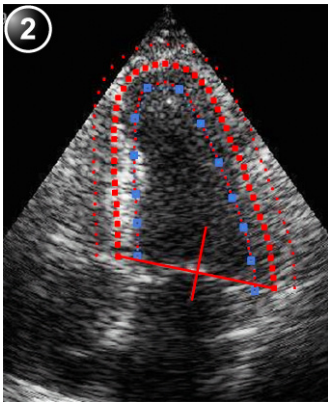
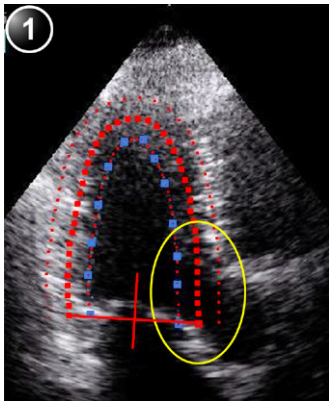
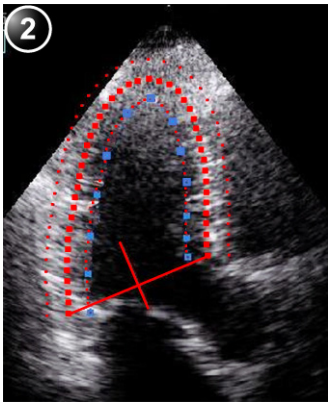
Figure 10-3: Auto ROI creation

Guidelines for the ROI definition

- When tracing the myocardial border, the first and last point should be placed at the connection between the mitral ring and the wall (“hinge point”), except in the long axis view where the anteroseptal end point should be set at the border between the anteroseptal wall and the outflow tract.
- The ROI should be defined as a smooth curve, avoid to warped curves. Make sure the pericardium is not inside the ROI. Some amount of blood area within the ROI may be OK.

The following examples illustrate typical errors that should be avoided when defining the ROI.

Wrong	Correct	Comment
		1. The ROI is too wide and extends beyond the epicardial borders 2. Correct ROI definition
		1. The ROI is too narrow, and does not contain enough information for tracking. 2. Correct ROI definition
		1. The ROI should not follow the bulging, as this results in the ROI central line not being in the direction of myocardial contraction. 2. Correct ROI definition

Wrong	Correct	Comment
		1. The apical point is too high, extending beyond the epicardium. 2. Correct ROI definition
		1. The right border of the ROI is way too much into the chamber cavity. 2. Correct ROI definition
		1. The ROI should not extend into the aortic cavity. 2. Correct ROI definition

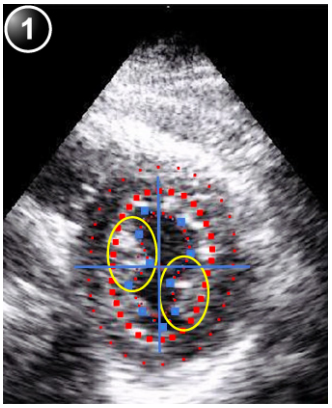
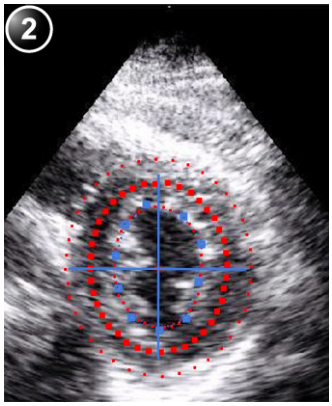
Wrong	Correct	Comment
		1. The ROI should not be traced through the papillary muscles. 2. Correct ROI definition

Figure 10-4: ROI definition guidelines

Adjusting a ROI

Each point in the trace can be moved to modify the ROI as described below:

1. Press **Recalc**.
2. Place the mouse cursor over a point to move in the trace. The trace and the point are highlighted.

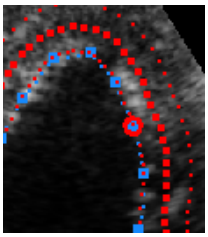


Figure 10-5: Highlighted point

3. Press the Left mouse button and move the point.
4. Press the Left mouse button to place the point in the new location.
   The ROI is updated accordingly.
5. Data processing is started automatically if the cursor is not moved for a few seconds.
   Note: The auto processing function is configurable (from Config/Meas-Text/Advanced/AFI auto processing.)

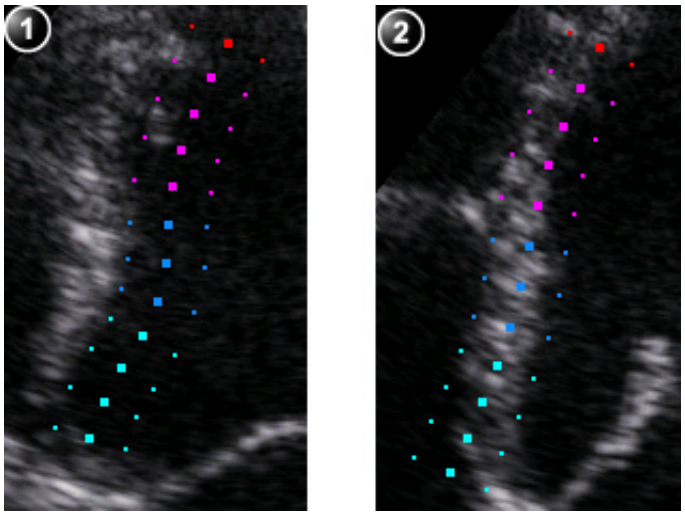
Other adjustment:

1. Use the control **ROI width** to adjust the width. Make sure the ROI covers the region to be analyzed.

Single wall ROI adjustment

When tracing a ROI for a single wall, the generated ROI may have to be adjusted relatively to the myocardial border.

1. Press **ROI side** to move the ROI to the correct side of the myocardial border (Figure 10-6).



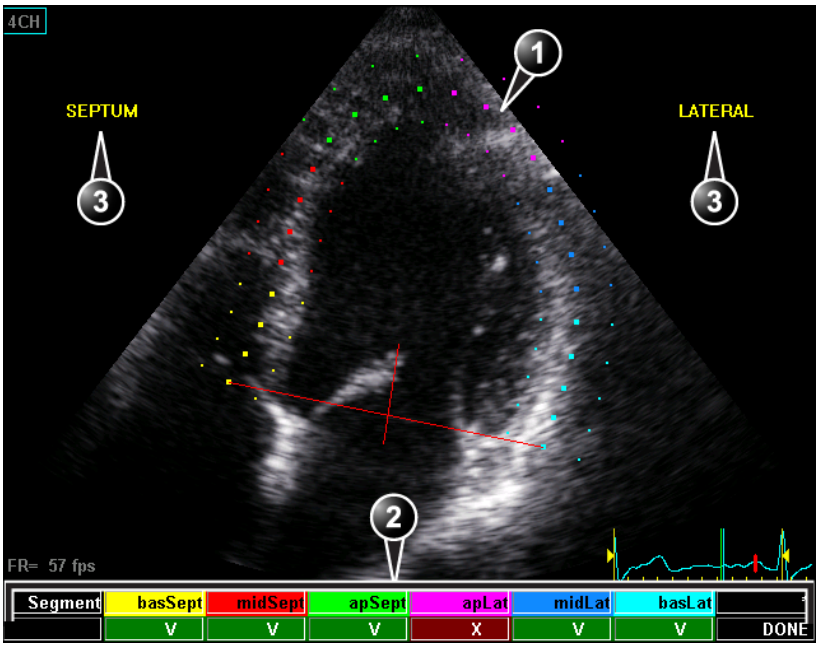
1. **Generated ROI on the wrong side of the myocardial border**
2. **Adjusted ROI**

Figure 10-6: Single wall ROI adjustment

2D Strain processing

2D Strain processing divides the ROI into segments and evaluates the tracking quality for each segment. The user has to review and validate the tracking evaluation for each segment.

1. The *Processing screen* is displayed showing the ROI divided into segments. The tracking quality for each segment is automatically evaluated and summarized in the *Tracking table* (see Figure 10-7).



1. **The ROI divided in segment**
2. **The Tracking table**
   - **V: valid tracking**
   - **X: not acceptable tracking**
3. **Segmental labels**

Figure 10-7: The Processing screen

Note: post-scan gain adjustment does not affect the 2D Strain processing. Live gain adjustment during acquisition will affect the 2D Strain processing, and should be adjusted for optimal imaging of the myocardium.

Tracking validation

The tracking for each segment must be visually controlled and validated.

1. Inspect each segment and make sure that the center line is moving together with the underlying 2D image. Refer to the Online help for additional information on tracking quality. To get a better visualization you may adjust the control **Bullets**

to add or remove bullets.
The tracking quality is automatically evaluated for each segment and displayed in the *Scoring table*. The user may override the tracking quality evaluation done by the system by clicking on the evaluation result in the Tracking table.
If the tracking quality needs to be improved, select **Recalc**, re-adjust the ROI as described on page 346.

2. Once the tracking quality has been controlled for all segments, press **Approve** in the *Scoring table*.
If running 2D Strain on an APLAX view, you may adjust the AVC timing as described below.
If running 2D Strain on another view than the APLAX view, the *Trace analysis screen* is displayed (see page 351).

Timing

Timing information may be crucial for accurate diagnosis. The most important timing is the aortic valve closure (AVC), since it is part of the definition of important parameters such as peak systolic strain or peak systolic strain rate. In 2D Strain time events e.g. time to any systolic parameter is always measured from the estimated time of AVC. This is different from the definition in TSI for example, where timing is measured relative to the QRS.

Determination of the AVC timing by the system is as follow, depending on the situation:

- If AVC timing has been measured by the operator (through an event timing measurement) the system is using this data.
- If not measured by the operator, the default AVC timing is used, determined by the temporal contraction of all LV segments (Strain curves).
- From the APLAX view, the user can adjust the estimated AVC timing. The adjusted AVC timing will then be used in the other apical views. This option is only available from the APLAX view.

AVC timing adjustment

This procedure is available in the APLAX view only.

1. After validation of the tracking quality. the frame for the current AVC setting (default or event timing measurement)

is displayed and highlighted on the ECG.

2. To keep the current AVC setting, press the Left mouse button. To change the AVC setting, use the mouse to display another frame and press the Left mouse button. If the AVC setting was changed, a *Confirmation window* is displayed. Select one of the following options:
   - **Manual** to accept the manual AVC setting.
   - **Event timing** to reject the manual AVC setting (if for example the AVC setting was not possible to assess from the APLAX view). The AVC event timing measurement will then be used.
   - **Auto** to reject the manual AVC setting and use the default AVC timing.

2D Strain quantitative analysis

2D Strain quantitative analysis enables full data analysis in both numerical, parametric color coding and graphical forms for any point within the ROI in any frame in the cineloop.

The 2D Strain quantitative analysis is available through:

- The *Trace analysis screen*: provides a local graphical display of various selectable parameters as a function of time (curves) and color coded parametric display in the 2D and M-Mode windows.
- The *Single analysis screen*: provides a display of various selectable parameters as a color coded large size 2D cineloop.
- The *Quad analysis screen*: provides a segmental graphical display of various selectable parameters as a function of time (curves) and color coded parametric display in the 2D and M-Mode windows.
- The *Result analysis screen*: provides both numerical and graphical display of the results.
- The *Bull's eye screen* and *Bull's eye with traces screen*: provide parametric imaging (both numerical and graphical) of entire LV of the various selectable parameters. These screens are available only when APLAX, 4-chamber and 2-chamber views have been processed.
- The *Torsion screen*: provides a graphical display of the global apical and basal rotations and Torsion. From this screen, the user may also display global apical and basal rotation rates and torsion rate. This screen is available only when apical short axis (SAX-AP) and mitral valve short axis (SAX-MV) views have been processed.

These screens are available only when all segment tracking scores have been approved (see page 348).

About the results

Be aware of the following:

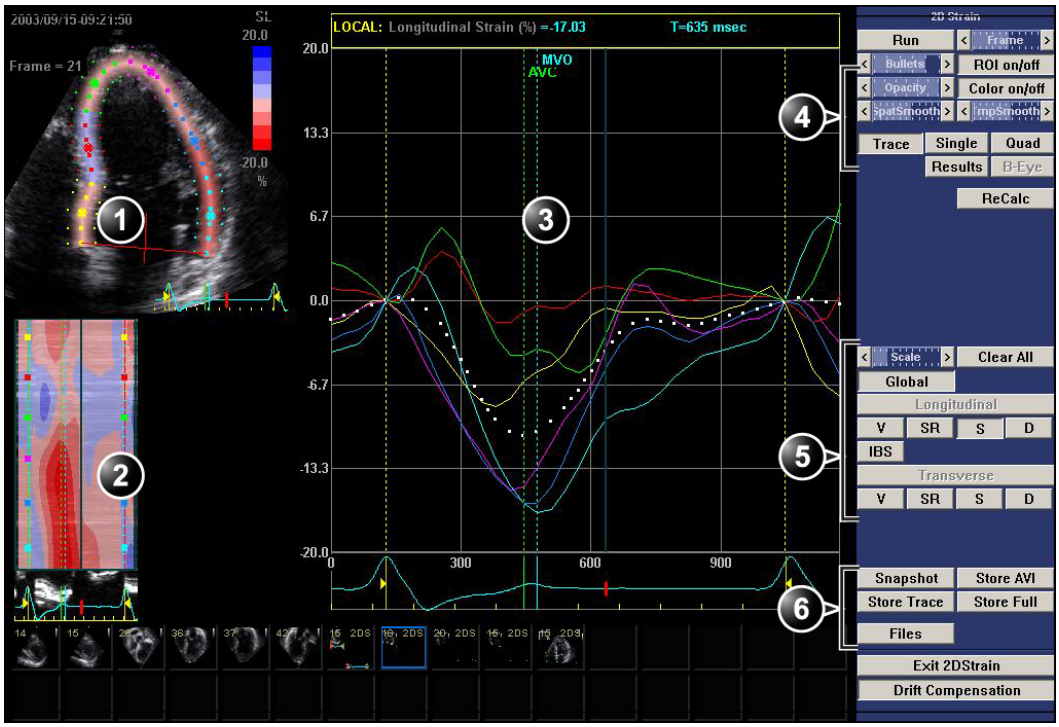
- Assessments should be made based on both color and segmental Peak systolic strain values.
- The Save As function is intended for research purposes and should not be used to archive diagnostic data.

- To populate the worksheet and the report the Single Bull’s eye screen must be saved.
- Any strain drifting is linearly compensated throughout the cycle. If the drift compensation in a given segment is too high, the tracking quality is automatically set to Not acceptable (**X**).

Trace analysis

To start the Trace analysis:

1. The Trace analysis screen is automatically displayed after validating the tracking.
   The *Trace analysis screen* displays the traces for the selected parameter for the marked point at the center of each segment and color coded parametric overlay in the 2D and M-Mode windows.



1. **2D Cineloop with parametric color coding**
2. **M-mode with parametric color coding**
3. **Trace display for the selected parameter**
4. **Display adjustment controls**
5. **Parameter selection panel**
6. **File storage and management controls**

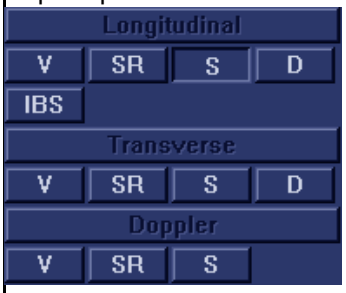
Figure 10-8: The Trace analysis screen

2. In the control panel, select a parameter to display the corresponding traces for all segments (see also page 354).

3. The following adjustments may be done:
   - Move the mouse cursor to any point in the ROI in the 2D or M-Mode window to display numerical parameter value and temporal trace for the highlighted point.
   - Adjust the **Scale** in the Trace window.
   - Adjust the **Opacity** of the color coded parametric display in the 2D and M-Mode window.

Parameters

The following calculation parameters are available:

Apical parameters  Short axis parameters 	• **V**: Velocity • **SR**: Strain rate • **S**: Strain • **D**: Displacement • **IBS**: Integrated back scatter • **RotR**: Rotation rate (short axis only) • **Rot**: Rotation (short axis only) The parameters in the Doppler section are based on Doppler only (available only if TVI data is present).

Display options

Single screen

1. Select **Single**.
   The cineloop is displayed in a single screen with color coded parametric information.
2. Use the Display adjustment controls (see Figure 10-8) to optimize image quality.

Quad screen

1. Select **Quad**.
   A Quad screen is displayed showing the cine loop in the upper left quadrant, color coded parametric still image in the bottom left quadrant, color M-Mode window in bottom

right quadrant and segmental traces in the upper right quadrant.

2. To display a color coded parametric image for another parameter, select the heading of the color coded parametric image and choose another parameter.

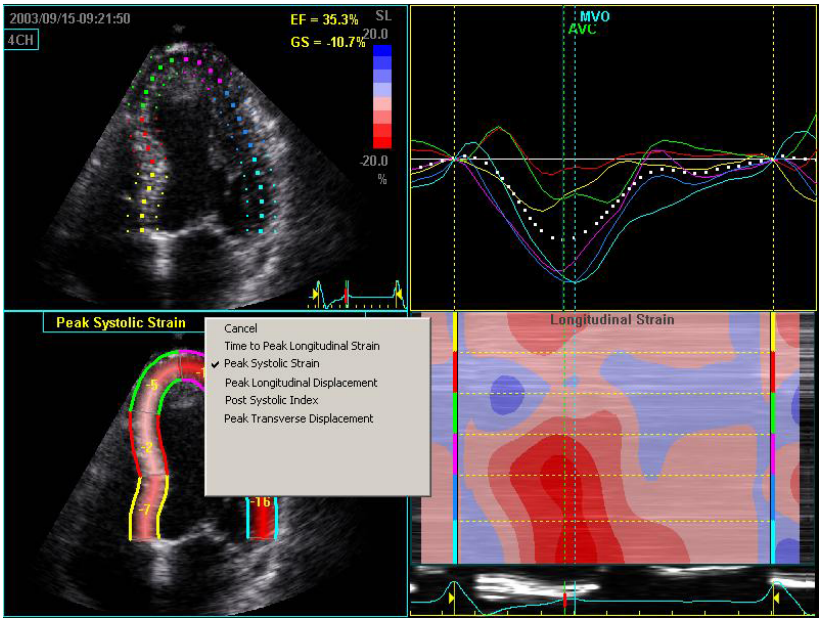


Figure 10-9: The Quad screen

Bull’s eye and Bull’s eye with traces screen

1. When APLAX, 4-chamber and 2-chamber views have been processed, the **B-eye** button becomes active. Select **B-eye**.
   A Bull's Eye screen is displayed showing the color-coded parametric image in Bull's Eye schematic form.
2. To display a color-coded parametric image for another parameter, select the heading of the color coded parametric image and choose another parameter.

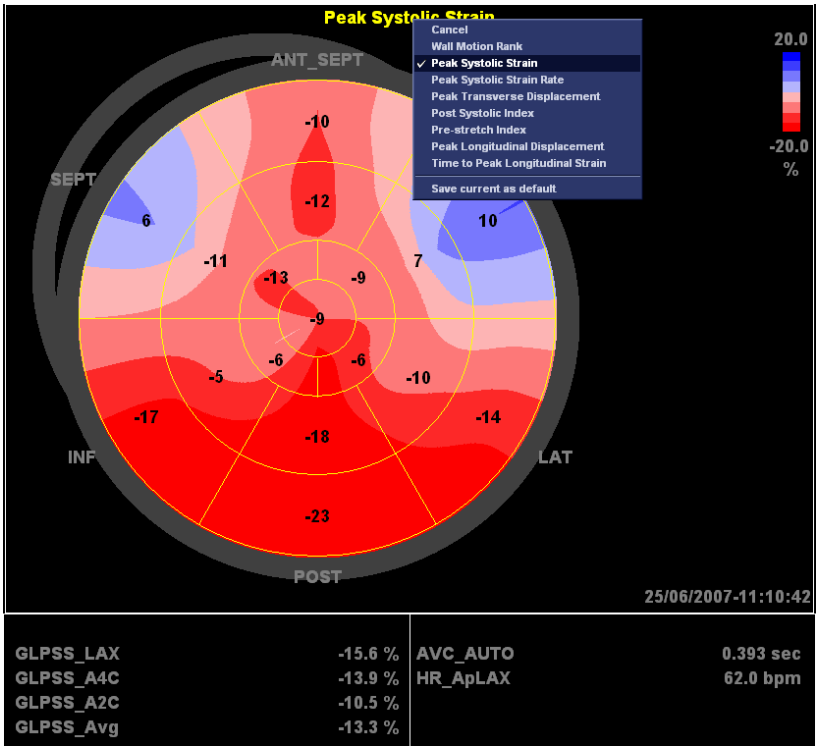


Figure 10-10: The Bull's eye screen

3. To display segmental traces and Bull's eye, select **BE Traces**.

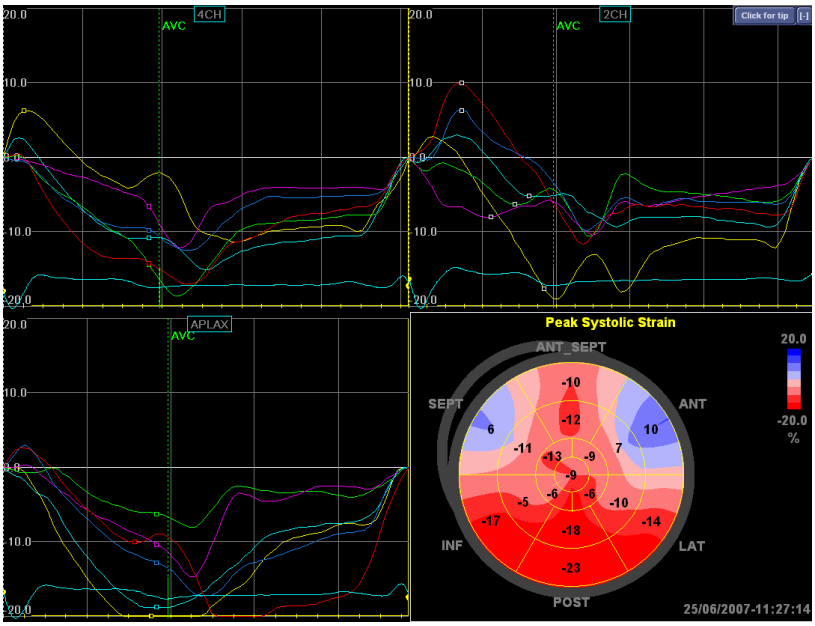


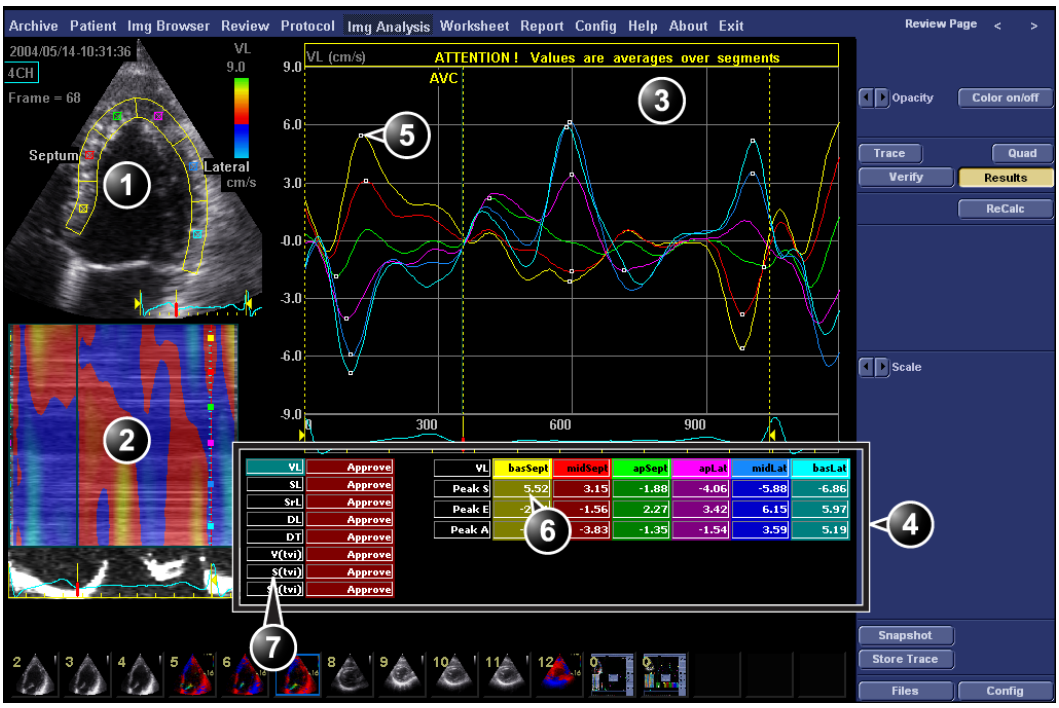
Figure 10-11: The Bull's eye with traces screen

Result analysis

The *Result quantitative analysis screen* displays the average traces for a selected parameter for each segment (averaged on all points in the segment) and corresponding peak values (Peak S, Peak E and Peak A). The peak positions in the curves must be controlled and approved.

Peak adjustment

1. Press **Result**.
   The *Result analysis screen* is displayed.



1. **2D image with segmented ROI**
2. **M-mode with parametric color coding**
3. **Trace display for the selected parameter**
4. **Peak result table**
5. **Peak marker**
6. **Peak value**
7. **Select a parameter**

Figure 10-12: The Result analysis screen

2. Select a Peak marker (white square point) on one of the traces.

The corresponding peak value is highlighted in the *Peak result table*.
OR
Select a Peak value in the *Peak result table*.
The corresponding Peak marker is selected.

3. Move the Peak marker to the correct position.
4. Press the Left mouse button.
   The corresponding Peak value is updated in the *Peak result table*.
5. Repeat the procedure for all Peak markers in all segments for the selected parameter.

Peak validation

Once all peak positions in all segments for the selected parameter are controlled, the results can be approved.

1. Select **Approve** in the *Peak result table* next to the selected parameter.
   A window is displayed prompting the user to save a snapshot.
   You may add a text to be added to the file name in the white text field.

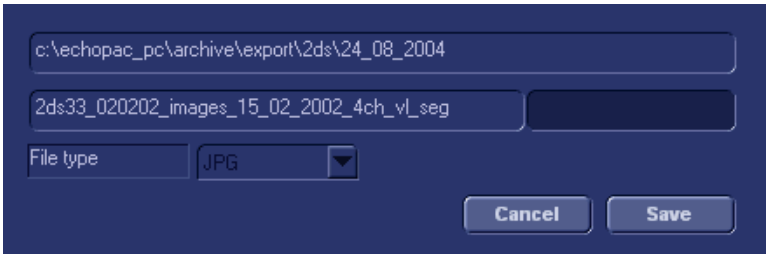


Figure 10-13: The store window

2. Select **Save**.
   A snapshot of the screen is saved to the local hard disk.
   To retrieve snapshots, see page 362.
3. Select the next parameter in the *Peak result table* and repeat the Peak adjustment and validation procedures.

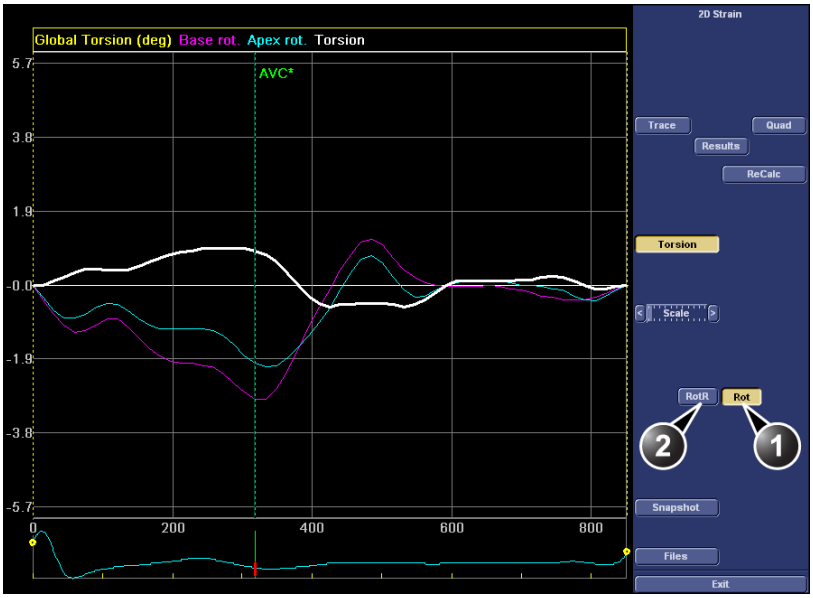
Torsion analysis

The *Torsion screen* displays the global apical rotation, global basal rotation and global Torsion traces. The Torsion parameter

is calculated as the difference between the apical and basal rotations.

The *Torsion screen* is available only when apical short axis (SAX-AP) and mitral valve short axis (SAX-MV) views have been processed.

From this screen, the user can also display the global apical rate, basal rotation rate and torsion rate traces.



1. **Display global apical and basal rotations and global Torsion.**
2. **Display global apical and basal rotation rates and global Torsion rate.**

Figure 10-14: The Torsion screen

When processing the SAX-AP and SAX-MV views, make sure that:

- The acquisitions should have only one heart cycle.
- Both acquisitions should have similar heart rate and frame rate.
- The cineloop markers should be placed in the same position in both acquisitions.

To display the *Torsion screen*:

1. Process the SAX-AP and SAX-MV views. The Torsion

button is displayed.

2. Press **Torsion**.
   The *Torsion screen* is displayed (see Figure 10-14) showing the global apical and basal rotation curves and global Torsion curve.
3. Press **RotR** to display the global apical and basal rotation rate curves and global Torsion rate curve.
4. Press **Snapshot** to save a screen shot of the curves.

Data storage and retrieval

Data storage

The user may store:

- Snapshot (JPEG format) of the *Trace analysis screen* or *Result analysis screen* (**Snapshot** button).
- AVI file with running cineloop in the T*race analysis screen* or *Result analysis screen* (**Store AVI** button).
- Trace data for the current screen (**Store trace** button).
- Trace data at all nodal points along the ROI, available from the *Result analysis screen* (**Store full** button).

To store data:

1. Select one of the storing options.
   The *Store window* is displayed.
   The location, name and type of the stored file are shown in upper, mid and bottom strings in the Store window. You may add a text to be added to the file name in the text field.

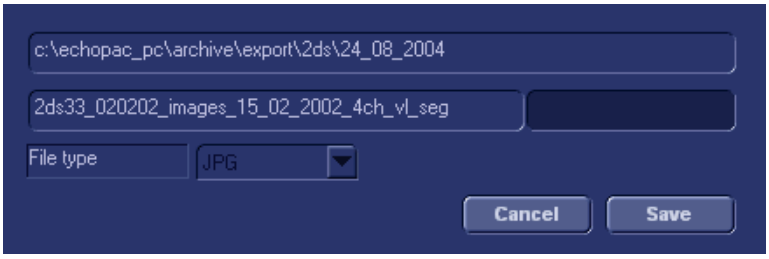


Figure 10-15: The Store window

2. Select **Save**.
   A file is saved to the local hard disk.

File management

Stored files can be retrieved after copying them from the local hard drive to a CD-R or a shared network folder.

If a shared network folder is used, the path (of type: \\SERVER-NAME\SHARED-FOLDER) must be entered in the *Remote path field* in **Config**/**Connectivity**/**Tools**.

1. In the *Trace analysis screen* or in the *Result analysis*

screen, select **Files**.
The *File management window* is displayed showing the available files in the *Available items field*.

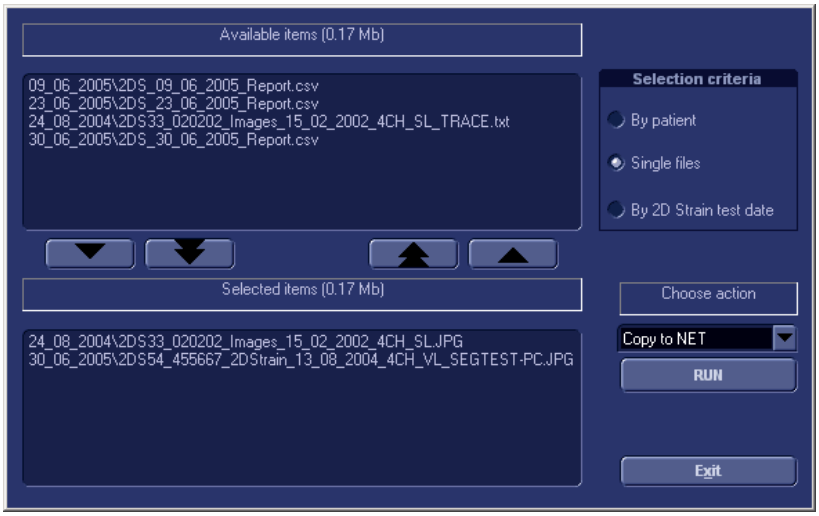


Figure 10-16: The File management window

2. Check the desired selection criteria and select one or several files in the *Available items field*.
3. Select the **Down arrow** button to move them over to the *Selected items field* (right side).
4. Under **Choose action**, select:
   - Copy to CD/USB Flash card
   - Copy to Net
5. Select **Run**.
6. The selected files are copied to the selected device.
7. The copied files can be opened from a regular PC.

2D Strain – Frequently asked questions

1. **Q:** What system settings should be used for acquiring best data for 2D Strain analysis?
   A: The 2D grey scale frame rate should be between 40 and 90 frames per second. Use only images of good quality where the entire myocardium is visible (not only the endocardial border). Slightly more than one cardiac cycle should be stored to allow adjustment of the QRS markers: configure the scanner such that when you save the loop, margins of 100 msec are saved at both ends of the heart cycle.
2. **Q:** Are there different criteria for TVI images than for 2D images?
   A: The same criteria apply (see Question 1). Note that the TVI and 2D grey scale images may have different frame rates. It is the 2D grey scale frame rate that should be between 40 and 90 frames per second.
3. **Q:** Is the peak of the R wave the starting point for the loop used for 2D strain analysis?
   A: Yes, the reference for the strain measurements is the end-diastolic state.
4. **Q:** How do I define the start and end points of the heart cycle?
   A: In most cases, when the ECG signal is good, you do not have to do anything, the software will do it automatically for you by analyzing the QRS complex. Sometimes the ECG signal is pour. In order to be able to handle these situations we recommend to manually shift the markers that define the heart cycle either prior to entering 2D Strain or within the 2D Strain package.
5. **Q:** How to decide End Systolic? I heard that you said there was some Paper how to decide end systolic by calculation. Could you please let me know the formula or paper / document?
   A: In the 2D Strain application, the End Systole (AVC marker) can appear in two ways:
   - If Event Timing of AVC has been determined prior to entering 2D Strain, the AVC marker is set to the same time as measured AVC.
   - If AVC has not been measured, AVC is automatically estimated based on the segmental peak longitudinal

strain values and times.

6. **Q:** Is “Right Twist” shown by red color and clockwise?
   A: Yes, clockwise rotation is measured as negative degrees and is colored red.
7. **Q:** How is the combination of greyscale and TVI information performed?
   A: If the data set contains TVI, the velocities within the ROI are first angle corrected to the actual motion direction found by 2D Strain processing. Next, the quality of the TVI and the 2D Strain data is estimated for each point within the ROI from the spatial variation around the point. The data type with the lowest variance is used for further processing.
8. **Q:** How is the result affected if the ROI covers both myocardium and blood?
   A: The processing uses a special filtering which ensures that the blood samples have minimal effect on the estimated strain values.
9. **Q:** How do we calculate rotation (twist)?
   A: The rotation (twist) is calculated as an angular displacement of each point of myocardium around the “center of gravity”. The start angle is zero at the beginning of heart cycle The rotation rate is the temporal derivative of the rotation. The Global Rotation is the averaged rotation along the ROI.
10. **Q:** What are the “global” values, and how are they found?
    A: The global values are calculated from the whole ROI as a single segment. Note that this is similar, but not necessarily identical, to averaging the values of all the segments.
11. **Q:** How is the Time to peak strain parametric image derived, and what do the quantitative values represent?
    A: The Time to peak strain parametric image color codes the time from start systole to the peak negative longitudinal strain. The quantitative values are in milliseconds.
12. **Q:** What are the start and end search times for the Time to peak strain parametric image, and can the user control these times?
    A: The start search time is end systole or AVC, and can be controlled by adjusting the AVC marker. The end search time is the QRS of the next beat, and is not adjustable. It is

possible to adjust Peak marker position manually (using Drag-and-drop) in the *Result analysis screen*.

13. **Q:** What are the consequences if the warnings for low frame rate etc. are ignored and analysis is performed anyway?
    A: Up to a certain limit, probably none. For images with a good image quality the tracking is good even for frames rates as low as 30 fps. The message will appear for frame rates below 40 fps.
14. **Q:** How can I use another heart beat than the second in a loop?
    A: The desired beat should be selected prior to entering the 2D Strain application.
15. **Q:** I am assuming that 90 fps is acceptable? With the higher frame rate acquisition this would give us a better temporal resolution when performing the 2D strain analysis.
    A: A too high frame rate tends to come in the expense of a reduced line density. This has a detrimental effect on tracking quality.
16. **Q:** Horizontal timing intervals are set at 15 msec. Can these be smaller?
    A: Timing interval is given by the acquisition frame rate.
17. **Q:** What is the strain length at longitudinal and transverse strain?
    A: We do not measure distances between selected points, rather we calculate strain based on interpolated positions of all points inside the ROI.
18. **Q:** What is the difference between Lagrangian strain and natural strain?
    A: There are several definitions for one-dimensional strain. One of them is the so-called Lagrangian strain, a.k.a. engineering strain, which is defined as *epsilon = (L-L0)/L0*. Another is the natural strain, a.k.a. logarithmic strain, which is defined as *epsilon_n = ln(L/L0)*, where *ln* means the natural logarithm. (The name “natural strain” comes from the use of the natural logarithm.) There is a direct mathematical relation between these two strain measures: epsilon_n = ln(epsilon + 1) or correspondingly epsilon = exp(epsilon_n) - 1, where “exp” is the exponential function. Using two different measures for the same property can be compared to presenting a

temperature either in Fahrenheit or in Celsius. If you know the natural strain, you can easily convert it to the Lagrangian/engineering strain and vice versa.

Appendix

• **Regulatory information** **370**
• **Short-cuts** **372**
• **System self-test** **376**
• **Product description** **378**

Regulatory information

The GE Vingmed Ultrasound product families are tested to meet all applicable requirements in relevant EU Directives and European/International standards. (See “Standards used” below.) Any changes to accessories, peripheral units or any other part of the system must be approved by the manufacturer: GE Vingmed Ultrasound. **Ignoring this advice may compromise the regulatory approvals obtained for the product.**

Please consult your local GE Vingmed Ultrasound representative for further details.

Standards used

The EchoPAC PC software is a Class I with measuring function device, according to the Medical Devices Directive 93/42EEC.

To fulfill the requirements of relevant EC directives and European Harmonized/International standards, the following documents/standards have been used:

Standard/Directive	Scope
93/42/EEC	Medical Devices Directive (MDD)
IEC60601-1-4: 1996+A1: 1999	General requirement for safety - Programmable electrical medical systems.

The EchoPAC PC software is installed and runs in a commercially available PC. According to applicable legislation, compliance to the following EC directives and European Harmonized/International standards are required for the PC in use:

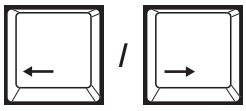
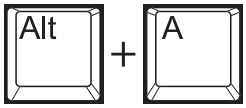
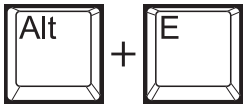
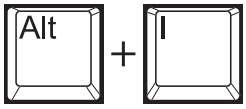
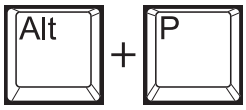
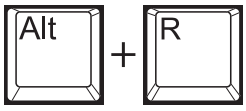
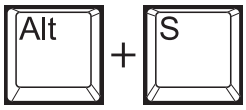
CE 0470

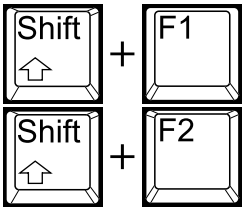
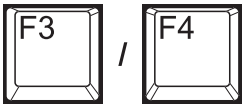
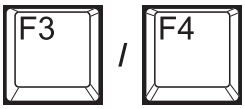
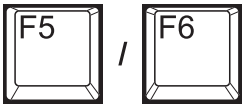
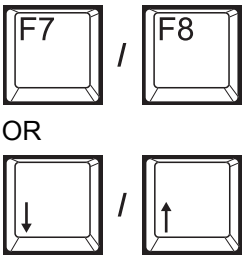
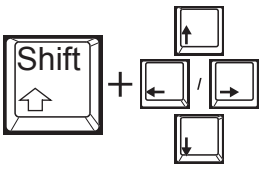
Standard/Directive	Scope
93/68/EEC	CE Marking Directive
89/336/EEC	Electromagnetic compatibility, EMC Directive
73/23/EEC	Low Voltage Directive

Standard/Directive	Scope
2002/96/EC	Waste electrical and electronic equipment (WEEE Directive)
2002/95/EC	Restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS Directive).
UL60950: 2000	US and Canadian standard for information Technology Equipment
IEC60950: 2001	Safety for Information technology equipment

Short-cuts

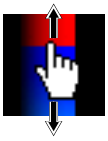
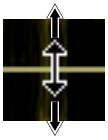
Keyboard short-cuts

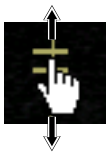
Short-cut	Description
	In Freeze, displays previous and next frame. Disabled when Direct report is activated.
	Displays previous state (window).
	Starts **Annotation** application
	Ejects removable media
	Store screen image to clipboard.
	Print
 OR 	Run/stop cineloops. Space bar does not start/stop cineloop when Direct report is activated.
	DICOM spooler

Short-cut	Description
	• **SHIFT** + **F1**: In the *Analysis screen*, select previous image. • **SHIFT** + **F2**: In the *Analysis screen*, select the next image.
	Help: starts **On line user manual**.
	Starts EchoPAC PC configuration package.
	• Adjusts **Cine speed** when the selected cineloop is running (**F3** = decrease, **F4** = increase). • Enables **Frame scrolling** when the selected cineloop is frozen (**F3** = backward, **F4** = forward).
	Adjusts the **Baseline** when a Doppler window is selected (**F3** = up, **F4** = down).
	Adjust the **Horizontal sweep speed** when a Doppler window is selected (**F5** = decrease, **F6** = increase).
	• **F8** or **ARROW UP**: **zoom in** • **F7** or **ARROW DOWN**: **zoom out** The Arrow keys do not control the Zoom function when Direct report is activated.
	**Panning tool** when in Zoom mode Disabled when Direct report is activated.

Short-cut	Description
F9 / F10	Adjust **Compression** (F9 = decrease, F10 = increase).
F11 / F12	Adjust **Reject** (F11 = decrease, F12 = increase).

Mouse short-cuts

Short-cut	Description
	Zoom: select any point in a image and drag upward to zoom in, downward to zoom out.
Shift +	**Panning tool** in Zoom mode: press and hold down SHIFT, select any point in the image and drag around to display the different parts of the image.
	Color modes: select any point in the color bar and drag vertically to change the **Baseline** position.
	Select the **Start** or **End cineloop marker** and drag horizontally to adjust the position.
/	In freeze: select the frame marker on the ECG and drag horizontally, or select any point on the ECG to display another frame.
	Doppler: select the **Baseline** and drag vertically to change its position.

Short-cut	Description
	Doppler: select any point in the Doppler spectrum (except for the baseline) and drag horizontally to adjust the **Horizontal sweep**.
	Anatomical M-Mode: select the **AMM cursor** and drag vertically to change the position.
	Anatomical M-Mode: select the **AMM angle cursor** arrow head and drag horizontally to change the angle.
	Tissue Tracking/Strain: select the **Start** or **End marker** and drag horizontally to change its position.

System self-test

The EchoPAC PC ultrasound unit is designed for reliable operation and consistent, high-quality performance. Automatic self-testing facilities are provided to monitor system operation and to detect malfunction as soon as possible, thereby eliminating unnecessary downtime. The detection of any serious malfunction may result in immediate interruption of scanner operation.

System malfunction

In the event of error or system malfunction the user may generate and export a log file to a removable media as described below and contact authorized service personnel.

Generating a logfile

1. Press **ALT** - **D** on the alphanumeric keyboard.
   The *Problem description dialogue window* is displayed (see Figure 1-1).
2. Type in a description of the problem. Notes should be made regarding the selected probe, the imaging mode and the application that was being used at the time of malfunction. If applicable, try to describe the button or key pushing sequence that immediately preceded the problem. Check the mention *System lockup* if applicable.
3. Press **Save** to create a logfile.

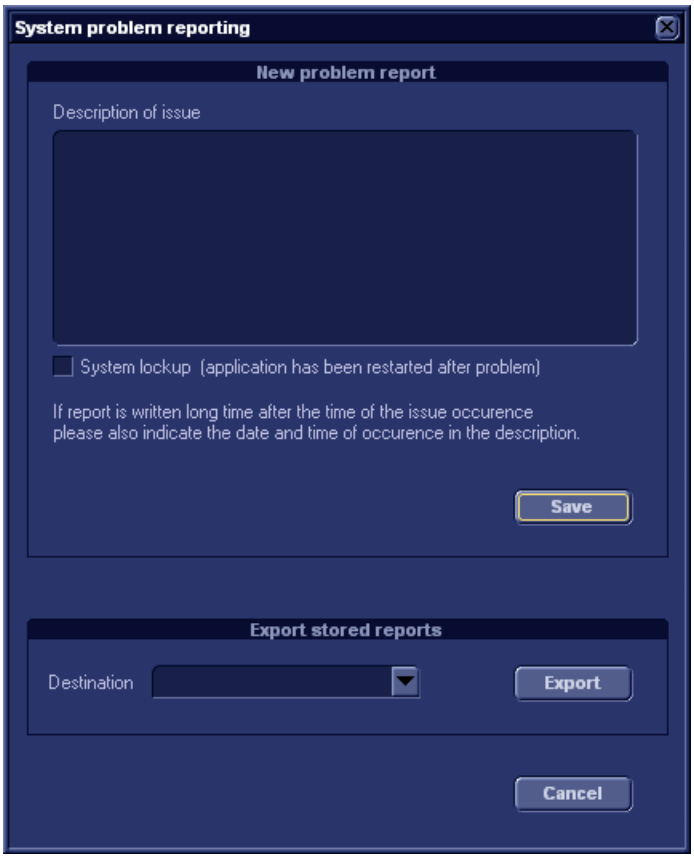

System problem reporting
New problem report
Description of issue
System lockup (application has been restarted after problem)
If report is written long time after the time of the issue occurence
please also indicate the date and time of occurence in the description.
Save
Export stored reports
Destination
Export
Cancel

Figure 1-1: The Problem description dialogue window

Exporting the logfile

1. Press **ALT** - **D** on the alphanumeric keyboard to display the *Problem description dialogue window* again.
2. Select the destination where to export the logfile (MOD or CD-R).
3. Press **Export**.
   A Zip file (named “logfile_<date>_<time>.zip”) is copied on to the selected removable media.

Product description

Multi-dimensional and Volume Imaging (option)

- 4D option display of volume data in gray scale
- Multi-plane images, parasternal bi-plane and apical tri-plane views are displayed
- 2D, color, as well as, Tissue Doppler modes (including Tissue Synchronization Imaging which is part of the Advanced QScan option)
- Full volume gray scale data displayed from 4 or 6 sequential heart cycles
- Slice mode allows an anyplane gray scale display based on volume data
- Comprehensive control set for optimizing rendered 4D image display
- Full M&A package can be applied to multi-dimensional and slice mode images
- All data can be stored in raw data DICOM format and can be recalled for post-processing
- Access serial exam image sets quickly in EchoPAC PC Dimension Image Browser. Sonographers and Physicians review and compare previous exams with the current exam within seconds
- EchoPAC PC Dimension displays 4D Stress Echo exam data sets in a user defined protocol format for efficient review and analysis. High quality assurance is provided with each data set by leveraging the advantages of 4D multi-dimensional acquisition and review parameters
- 9-Slice. Reconstruct automatically 9 equidistant, parallel horizontal views from a 4D Full Volume data set. This allows to get automatically short axis views from an apically acquired volume. The position of the 9 slices can be adapted to the real anatomy in angle and distance.

EchoStress (option)

- Review of stress-echo studies acquired with the Vivid 7, Vivid 4 or Vivid 3 as well as other DICOM ultrasound systems

- User-configurable exam templates and labels including settings for pharmacological and exercise stress, single loop and continuous loop capture
- Continuous loop capture
- up to 14 levels
- up to 10 projection views
- User-definable groups
- Heart rate and ECG stored with each loop
- Parallel raw data acquisition of greyscale 2D and tissue velocity information for quantitative stress analysis
- Qualitative Wall motion scoring
- Quantitative TVI Stress analysis: provides three different analysis tools based on TVI data stored during stress acquisition:
  - Vpeak measurement: enables the display of a tissue velocity trace for a selected region of a previously scored segment through the entire heart cycle
  - Tissue Tracking: enables visualization of the heart contraction at peak level by color-coding the displacement in the myocardium
  - Quantitative analysis: enables further quantitative analysis based on multiple tissue velocity traces
- M&A capability
- Report capability

Quantitative Analysis TVI (option)

- Multiple time-motion trace display from selected points in the myocardium
- Arbitrary straight Anatomical M-Mode
- Arbitrary curved Anatomical M-Mode

IMT

- Automatic measurement of Inter Media Thickness of the carotid artery. The algorithm works for raw data images from GE Vivid family of ultrasound scanners.

Tissue Synchronization Imaging (option)

- Parametric imaging which gives information about synchronicity of myocardial motion
- Delayed myocardial segments produce red overlay whereas segments with early motion are green
- Available in live scanning as well as an offline calculation derived from tissue Doppler data
- Additional features in combination with multi-plane imaging option:
  - Efficient segment specific TSI time measurements
  - Immediate Bull's eye report
  - Automatic calculated TSI synchrony indexes
  - TSI surface mapping
  - LV synchronization report template

Review and Analysis

Access 4D data sets from Vivid 7 Dimension on EchoPAC PC Dimension:

- Utilizing Tri-plane technology with Tissue Synchronization Imaging, clinicians have the ability to gain a better understanding for patient dyssynchrony. EchoPAC PC Dimension Tri-plane TSI is also a communication tool for displaying patient dyssynchrony to referring physicians and specialists

EchoPAC Share

"EchoPAC Share" is a software option that allows to connect up to three EchoPAC PC or Vivid clients to an EchoPAC PC Workstation. This is for small network settings, typically for a physician's office, where investment in an Image Vault server is not relevant, but where there is a need to have a network with a central archive. With this software option an EchoPAC PC Workstation can be used as the central archive. The software option "EchoPAC DICOM Share" allows to connect also non-GE scanners via DICOM Storage. Max. two non-GE scanners can be connected, plus one GE client. So if both software options "EchoPAC Share" and "EchoPAC DICOM Share" are

activated, up to four GE clients + up to two non-GE clients can be connected to a single EchoPAC PC Workstation.

Image Review

- TruScan Architecture allows for instant access/recall to digital raw data for uncompromising analysis and reporting or DICOM images
- EchoPAC PC Image Browser displays from current and stored exams for quick and efficient serial image review
- Thumbnail image display for quick overview
- Image play, freeze, and single frame advance are possible in the Image Review screen
- Flexible image layout: with multiple images allows for serial comparison of image data from different exam dates (up to 12 images - single frames and cineloops)

Image post-processing

- GE raw data enables full “scanner” post-processing functionality:
  - Anatomical M-Mode
  - Compress/Reject
  - Gain
  - Cine speed adjustment
  - Freeze/unfreeze
  - Frame-by-frame review of cineloop
  - Up/Down and Invert
  - Zoom and pan facility
  - Color map selection
  - DDP control
  - Color display on/off
  - Horizontal sweep adjustment
  - Baseline shift
  - Physiological traces control (gain and position)
  - Tissue priority
  - Variance

Workflow/Productivity/Connectivity

- Digital raw data (single frames and cineloop of 2D, M-mode, TVI, Spectral and Color Doppler modalities) at original resolution and frame rate from the Vivid 7, Vivid 4, Vivid 3 and Vivid i ultrasound units
- DICOM Media Read (Magneto-Optical Disk, CD and DVD)
- ECG, phono and three auxiliary traces recorded with raw data capture
- EchoPAC PC Dimension creates Mpeg image files and attaches a MPEG viewer to enable physicians and sonographers to view images on conventional PCs running Windows 2000 and XP
- Quality Image sets can be copied and saved on to removable media (CD, DVD, MOD, USB Flash Card) by EchoPAC PC Dimension for DICOM Media interchange as well as Mpeg, Jpeg and AVI formats

Patient and Record and Image Management

- Shared patient archive with Vivid 7, Vivid 4, Vivid 3 and Vivid i
- Ultimate workflow with instant access data management
- Fast search and recall of patient studies
- Physicians can search on their name and patient file to view if a report has been completed or not with one click
- Stress, Pediatric, Vascular, and many other exam categories can be searched and viewed with one click
- Patient Browser Screen for registration of demographic data and quick review of image clipboard contents
- Storage of single-frame, multi-frame and raw data image in raw data DICOM format J DICOM Media Store (US and US-MF and Secondary Capture) to Magneto-Optical Disk CD
- DICOM Network Storage to DICOM server
- Storage of reports and worksheet
- Export of reports as PDF, CHM, and Excel formats
- MPEGvue to save an entire exam as an MPEG, MPEG is embedded on to CD, MOD, DVD and USB Flash Card

- Export of cineloop as AVI
- Export of single frame images as JPEG
- ASE-recommended, report-structured text statements help create reports in minutes on Vivid 7, or on the EchoPAC PC
- Report function includes: Patient Information, Measurements, Calculations, Ultrasound Images and Wall Motion Scoring
- Pre-defined clinical report templates for cardiac, vascular, general imaging, OB and small parts
- Completely configurable report templates
- Printable on ink-jet printer and laser printer
- Report can be exported as PDF, CHM and Excel formats
- Pre-defined and configurable Structured Findings for efficient generation of the echo study findings. The findings will populate the final report.
- Normal Values. Each measurement can be given a normal range, and measurements in the report falling outside the normal range will be highlighted.
- Report and view images and measurements at the same time
- Direct Report program to select or create fully configurable text statements
- Measurements created on the Vivid ultrasound system automatically populate the EchoPAC PC worksheet
- Measurements created on ultrasound systems other than Vivid are manually entered into the EchoPAC PC worksheet
- EchoPAC PC worksheet measurements selected by the physician and sonographer auto populate the EchoPAC PC report

DICOM (option)

- Storage
- Read/write images on DICOM format (US, US-MF and secondary capture)
- Verify
- Query/Retrieve
- DICOM Print

- DICOM SR Storage

Ease of use

Measurements from Vivid 7 Dimension, Vivid 4, Vivid 3, Vivid i and conventional DICOM ultrasound systems populate the EchoPAC PC report from the EchoPAC PC worksheet. Physicians decide which measurements will be displayed on the final report. The sonographer or physicians on the fly can customize templates for echo, vascular and stress reports without system programming experts

Hardware

- HP Workstation
- Pentium 4, 3.00 GHz or greater
- 512 MB RAM
- 160 GB Harddrive
- DVD write, DVD-R
- 19" Monitor
- 17" LCD Screen (option)
- 9.1 GB 5.25 Magneto-Optical Disk (option)
- 1.3 GB 3.5 Magneto-Optical Disk (option)
- 250 MB Zip drive (option)

Software

- Microsoft Windows XP embedded

Virus Protection

- Lock-down configuration to prevent access through unused ports
- Vulnerability scanning and evaluation of new security patches for third-party technology
- Microsoft (and other) security patches that address serious issues will be made available to customers after GE tests and validates the security patches. It is imperative that GE tests the security patches for any potential impact on the operation of the Vivid ultrasound systems and EchoPAC PC workstation.

Safety

- Built to meet the requirements of:
  - EchoPAC PC software is CE Marked in accordance with 93/42/EEC Medical Device Directive
  - Computer hardware is CE Marked and in compliance with relevant EU directives 89/336/EEC Electromagnetic compatibility - EMC Directive, 73/23/EEC Low Voltage Directive, 2002/96/EC Waste electrical and electronic equipment (WEEE) and 2002/95/EC Restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS).
  - IEC/UL 60950

CAUTION

Not all features or products described in this document may be available or cleared for sale in all markets. Please contact your local GE Medical Systems representative to get the latest information.

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